SCIENCE

VOL. LXXII FRIDAY, AUGUST 8, 1930 No. 1858

Glozel, a Mystery: DR. DAVID RIESMAN 127
Preparation of Scientific Articles: PROFESSOR W. M. DAVIS 131
Obituary:
Recent Deaths; Memorials 134
Scientific Events:
Science Service Radio Talks; Plans of the Scripps Institution for Cooperation with Eastern Agencies; The Fourth Greenland Expedition of the University of Michigan; The International Conference of Agricultural Economists; The British Medical Association 135
Scientific Notes and News 138
Discussion:
The Relation between a Neglected Class of Facts and the Universal Law of Organic Evolution: PROFESSOR W. H. LONGLEY. *There is No Control:* PROFESSOR C. W. WOODWORTH. *Black Walnut Canker:* DR. C. R. ORTON. *Dutch Elm Disease in Ohio:* CURTIS MAY. *The Phototropy of Ultra-violet Transmitting Glasses:* DR. LYMAN CHALKLEY, JR. *The Rate of Work Done by a Ricksha Coolie:* ALVAN L. DAVIS 141
Special Correspondence:
Field Work of the National Museum of Canada: W. H. COLLINS 144
Quotations:
The Winnipeg Program of the British Medical Association 145
Scientific Apparatus and Laboratory Methods:
The Iowa Piano Camera: JOSEPH TIFFIN and PROFESSOR CARL E. SEASHORE. *A New Mechanical Disintegrator:* PROFESSOR E. W. SCHULTZ and F. D. BANHAM. *A Method of Titrating Proteolytic Enzymes:* DR. FREDERICK L. GATES 146
Special Articles:
The Production of Homozygotes through Induced Parthenogenesis: PROFESSOR E. M. EAST. *The Production of Bacteria-free Amoebic Abscesses:* DR. L. R. CLEVELAND and ELIZABETH P. SANDERS. *The Specific Action of a Bacterial Enzyme on Pneumococci of Type III:* DR. OSWALD T. AVERY and RENE DUBOS 148
Science News x

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

GLOZEL, A MYSTERY[1]

By Dr. DAVID RIESMAN

UNIVERSITY OF PENNSYLVANIA

THOSE who have read something about Glozel may wonder why I speak of it here. Is it not a dead issue? No, for as a study of human credulity and as a commentary on the hot-headedness or should I say pig-headedness of many men of science, it will always occupy a prominent place in the history of civilization.

Although many of the audience are probably familiar with the main facts, I want to give a brief synopsis of the involved story. I say "story" advisedly, for from the very outset the mystery of Glozel has formed a fascinating tale, very much in the genre of our best thrillers, with plot and counter-plot, gum-shoe detectives and all the pertinent paraphernalia.

Glozel is a small hamlet of four farmhouses, about fifteen miles from the famous spa of Vichy. Emile Fradin, then a youth of eighteen and belonging to an old local family, was one day working in his grandfather's field when a cow suddenly slipped into an unsuspected hole. Fradin went to investigate and found that the hole led into an oval pit containing a variety of remarkable objects—bricks, tablets, vases—which he gathered and as soon as possible showed to the village schoolmistress, Mlle. Picandet. The latter in turn showed some of the tablets to M. Clément, a school teacher in la Guillermie. Eventually the news of the discoveries came to the ears of Dr. Albert Morlet, a surgeon of Vichy and an amateur archeologist. Thereafter Dr. Morlet and Emile Fradin together began to excavate at Glozel and brought to light more and more buried objects which they collected in grandfather Fradin's house and which Dr. Morlet described in detail in an endless series of articles in a literary journal, the *Mercure de France*. It was through this magazine—the *Atlantic Monthly*

[1] Read by invitation before the American Philosophical Society on April 24, 1930.

of France in more senses than one—that I became interested in the Glozelian discoveries. My interest was especially aroused by the claim of Morlet and others that an alphabet had been discovered at Glozel which antedated every other alphabet then known. I therefore decided while spending a vacation in the Auvergne to see Glozel for myself, but before doing so I determined to interview Dr. Morlet in Vichy. At first he suspected me of being an archeologist, but when in answer to a direct question I denied the soft impeachment and proclaimed myself merely a doctor, he became cordiality itself and showed me his collection of Gallo-Roman and Glozel antiquities. He told me that he as well as others had been inclined to consider Glozel as belonging to the Magdalenian age because of the presence of harpoons and of stones engraved with reindeer and other animals long extinct in France, but further studies had led to the conclusion that Glozel was Neolithic. Dr. Morlet kindly asked me to stay over until the following day and dig with him and Professor Björn, of Sweden, but I was unable to do so.

After leaving Morlet I motored, together with two American friends, to Glozel. Emile Fradin received us and at once offered to take us to the field of excavation. It was at the bottom of a deep ravine and was surrounded by a barbed-wire fence and scarred by trenches and holes. He showed us the original oval pit and the two tombs subsequently discovered. As it was raining hard and as the clayey ground was slippery, I declined his invitation to crawl into one of the tombs but asked instead to see the museum. After paying two francs each we entered through a low door above which was a crude sign with the pretentious words, *Musée de Glozel,* and found ourselves in a square low-ceilinged room with shelves on the walls and very primitive glass cases standing on the floor. The objects exhibited on shelves and in cases were astounding in number and variety—vases, tablets, engraved stones, ornaments especially pendants, some pieces of glass and harpoons, the last not nearly as artistic as those of Magdalenian age I had seen at Les Eyzies and at Laugerie-Basse. Three articles attracted my special attention—vases or vase-like pottery-ware having eyes, nose and ears but no mouth, which Morlet has called death masks, explaining the absence of the mouth by assuming that the primitive makers wanted to express the silence of the grave. Secondly, a squarish object suggesting the female figure with a cylindrical projection from the forehead interpreted as the phallus—this Fradin told me was a bisexual idol; and most striking of all, clay tablets with graven signs looking in every way like alphabetical characters. I was struck by the clean red color of these tablets. When I spoke of this to Fradin, he explained it by saying that the soil in which the tablets had been found was such that it did not readily fuse with the clay and hence was easily brushed off. There were also some large casts of the human hand which differed from the imprints of the hands in the Spanish and French caves in having all the fingers present.

I offered to buy some of the articles, especially a tablet, but Fradin resolutely refused to sell. During the whole of our stay in the museum, the grandfather stood silent and motionless in a doorway leading to an inner room.

The reputed discoveries of an alphabet dating back to Neolithic times of which I had now seen the alleged evidence in abundance created a tremendous sensation in informed circles. Altogether about 136 characters had been distinguished, representing every letter of the alphabet except the letter B.

Hitherto the credit for creating an alphabet had been given to the Phoenicians, but the oldest known Phoenician record found at Byblos a few years previously dated back only to about 1300 B. C.; Sir Arthur Evans's baffling Cretan inscriptions of ninety characters, to *ca.* 3000 B. C. If Morlet and those who agreed with him were right, then Glozel was truly what M. Reinach called it—one of the greatest archeological discoveries of all time.[2]

Almost immediately after the first appearance of Morlet's reports, doubts began to be voiced about the authenticity of Glozel, though in the early period of the controversy there were perhaps as many scientists who accepted the discoveries in good faith as there were doubters. Soon the pro- and anti-Glozelians became personal and attacked each other with a vituperative vehemence and a destructive sarcasm for which the French language appears to be the ideal medium. Reputations were shattered, old friendships broken, and—as one of the French dailies remarked—even butcher boys came to blows on the streets of Paris.[3] In fact Mrs. O'Leary's cow did no greater damage to Chicago than Fradin's to the reputation of some French savants.

Before long the leading French prehistorians with only an occasional exception began to deny altogether the authenticity of Glozel and to declare the excavated articles to be forgeries. A number of Englishmen were likewise unconvinced. However, Dr. Foat, a London scientist, makes the categorical statement that "if the finds of Glozel are not authentic, it is equally necessary to consider as false all that I have seen in

[2] Dr. Hackh in an exhaustive essay on the "History of the Alphabet" makes no reference to Glozel; if true, Glozel belongs at the very bottom of the linguistic tree.

[3] The Glozel affair has been made the subject of biting burlesque performances in Paris theaters and is the theme of a sarcastic novel by René Benjamin.

museums between London and Constantinople." Several Scandinavian, Belgian and Portuguese scientists also supported Dr. Morlet, and a German, Dr. Wilke, in a recent article enthusiastically upholds the standard of Glozel.

Are Dr. Morlet's supporters right or is Glozel but one more of the long series of frauds that history recounts since Jacob imposed upon his father Isaac? Many will come to your minds—Thomas Chatterton, our own Dr. Cook, Constantine Simonides, the pretended author of the Codex Sinaiticus, the forger of the Mecklenburg Declaration, the Lincoln love letters in the *Atlantic Monthly*, the Tiara of Saitapharnes, Ferrante Stocco, the Calabrian priest who created a saint, Giovanni Cala, and invented a life for him, and countless others. Two perhaps are germane and worth recounting. In the early eighteenth century George Psalmanazar, born in the south of France, came to England and with the connivance of a rascally clergyman, Alexander Innes, proclaimed himself a native of the Island of Formosa. He was lionized in London, wrote a description of the island which he had never seen and included in the book an alphabet and grammar of the Formosan language. Though many doubted his veracity, the book passed through two editions and was translated into French. Toward the end of his life he revealed himself in his own memoirs as a colossal faker and declared that all he had published including the language and the grammar was a hoax.

One of the most interesting cases and the one having the greatest analogy to Glozel, if Glozel be a fake, is that of the so-called "Figured Stones of Wurzburg."

In the first half of the eighteenth century there lived in Wurzburg, in Bavaria, an ultra-pious physician named Johann Bartholomaeus Adam Beringer. He is not remembered for any great discovery or contribution to science, but for his share in a remarkable scientific hoax. At the time in which Beringer flourished an active discussion was going on as to the source and meaning of fossils. Although Leonardo da Vinci had understood their true nature—even Herodotus, 400 B. C., had a correct idea—the scientists of two hundred years ago accounted for them as the result of "stone-making forces" of "formative qualities" or as growths from seeds. We may be inclined to smile, but with Dayton in Tennessee to chasten us, we can not throw stones at the Wurzburg of two centuries ago or at the Sorbonne which a hundred years later deprived the great Buffon of his chair because of his heterodox views.

Beringer had committed himself publicly to the belief that fossils were the capricious fabrication of God, hidden by Him in the earth for some inscrutable purpose. His zealous maintenance of this fundamentalist position led some of the students together with members of the faculty and wags of the town to make numerous fossils of clay which they buried in the side of a hill where they knew the professor was wont to search for specimens. Beringer chancing upon these objects was completely deceived. The jokers then became bolder and buried the most extraordinary and extravagant figures their whimsical imagination could suggest. They fashioned tablets bearing inscriptions in Hebrew, Babylonian, Syriac and Arabic and buried them not far from the original spot. Beringer was overjoyed to find such abundant confirmation of his doctrines, and forthwith in true German fashion proceeded to write an exhaustive treatise. The wags now began to realize that they had gone too far. They expostulated with him and revealed to him the whole truth. Instead of believing them Beringer became more than ever convinced that the story his frightened colleagues told was a ruse to rob him of the honor of his discoveries. No one could stop him. At great expense he published in 1728 the "Lithographiae Wirceburgenses."

Only too soon the shout of laughter with which the book was greeted brought the truth home to him. In chagrin and despair he exhausted nearly his entire fortune in a fruitless endeavor to suppress the edition and to buy up the copies already issued. He died soon afterwards, it is said, of a broken heart.

Is Dr. Morlet like Johann Beringer the victim of deception? Upon me personally he made the impression of an honest man. In certain quarters he was accused of fraud, for example, by the *Journal des Débats* and by the French Society of Prehistory. He promptly brought suit against these and won a verdict of 1,000 francs damages. The defendants carried the case to the Court of Appeals at Riom, the native town of Willa Cather's lovable archbishop. In confirming the verdict, the court gave expression to an amusing quibble. It held that Morlet, being a surgeon by profession and only by avocation a prehistorian, was not injured in the eyes of his real colleagues but only as an amateur archeologist. But as the defendants had not actually proved fraud, they were declared guilty of libel though the fine was reduced to one franc and costs.

Another humorous episode might be mentioned. Regnault, president of the French Society of Prehistory, sued a M. X— because he, Regnault, had been compelled to pay the sum of four francs to see a collection of fake objects. As part of this legal action, the police of Moulins broke into Fradin's premises and took away a number of objects which were afterwards submitted to the public expert, M. Bayle. The latter reported that the tablets were of

recent manufacture. Pieces of clay from a tablet crumbled readily in water; hence it was not conceivable that the tablets could have resisted the moisture in the ground had they been there for many years. Furthermore, a bit of grass picked out of a piece of earthenware showed under the microscope vegetable cells and chlorophyl,[4] and some of the bone instruments still contained marrow. Bayle was soon afterward shot to death by one Philopponet against whom he had testified in court.[5]

The Fradins themselves brought suit against M. Dussaud, member of the Institut, who in a trenchant brochure had called them fakers.

Let us now delve a little more deeply into this mystery so that we may understand better the basis of the whole controversy. The first serious doubt as to the authenticity of Glozel was based on the heterogeneity of the articles in Fradin's museum. How could one explain the presence of so many dissimilar and unrelated objects in one small field of excavation —the two or three thousand at the time of my visit have now grown to five thousand? No other archeologic site offers a parallel. Morlet answered this by saying that Glozel was a *champ des morts,* a cemetery, and that, as among many primitive peoples of later times, everything belonging to the dead had been buried with him. C. Jullian, who considers Glozel a Gallo-Roman station, accounts for the multiplicity of objects on the assumption that Glozel was a sorcerer's sanctuary. He has added greatly to the gaiety of nations by attempting a full translation of the inscribed tablets from the published illustrations. Dr. Morlet showed me with much amusement a crack in one of the tablets which Jullian had translated as a character.

Aside from the puzzling complexity of the collection, it has been pointed out that the tablets first exhumed bore fewer and less perfect characters than the later ones. Further, as soon as some one had made a criticism, the objects next exhumed would often be free from the criticized defect. Quite frequently certain features appeared that could be traced directly to scientific articles published shortly before. These facts seem of course very significant. Moreover, the scratches on stones whether representing animal figures or alphabetic characters were without the patina covering other parts of the stones, suggesting a recent production. Much was made of the penetration of roots into vases or tablets; but upon examination these roots were not found to be properly fossilized, which would have to be the case had the objects been in the ground for long ages. The utensils—harpoons, hand-axes, scrapers—are far less artistic than those in other Neolithic stations. Vayson de Pradenne and Abbé Breuil indeed contend that none of them could ever have been used.

Dr. Morlet and his chief supporter Van Gennep did their best to answer all these objections. The former at the height of the verbal battle-royal made a request for a governmental commission which was speedily granted, but when he found that a bitter anti-Glozelian, the well-known archeologist Capitan, was a member, he objected and the commission was never sent. Eventually, at the International Anthropological Congress at Amsterdam an International Commission was formally appointed to investigate Glozel. The commission consisted of Absolon, director of the Archeological Museum of the State of Moravia; Bosch Gimpera, professor in the university and director of the archeological work of Barcelona; the Abbé Favret; Forrer, director of the Prehistoric and of the Gallo-Roman Museum at Strasbourg; Miss Dorothy Garrod, member of the Royal Anthropological Institute and of the French Prehistoric Society; Hamal-Nandrin, lecturer on prehistory in the Museum of Liége; Peyrony, director of the Museum of Les Eyzies, and Pittard, professor of anthropology in the University of Geneva. Absolon was prevented from taking part in the work of the commission.

After spending three days at the site the commission issued a unanimous report which was kindly sent to me by Miss Dorothy Garrod. This report states unequivocally that the articles are for the most part of recent manufacture and have undoubtedly been planted in the ground by some one whom the commission does not name, and that Glozel is neither prehistoric nor authentic. Vayson de Pradenne, in a devastating brochure in which he declared the Glozel finds fakes, also accused no one by name but put the blame upon the *esprit de Glozel*—in other words, upon a fairy.

One might think with the leading French, English and American scientists—Peyrony, Pradenne, Abbé Breuil, Sir Arthur Evans,[6] Dussaud and, I believe, Professor MacCurdy—arrayed against Glozel, and with the destructive judgment of the international commission, that Glozel would cease from troubling the scientific and the lay mind. Though all due

[4] A report has just been made to the Académie des Sciences (*Mercure de France,* May 1, 1930; *La Dépêche de Vichy,* April 12, 1930) of the finding in Russia of chlorophyl in fossil plants of the Tertiary epoch, millions of years old.

[5] Bayle's reputation has been seriously tarnished through recent posthumous revelations. He suffered, as one writer puts it, from "mercantilitis," a post-war malady. A number of years ago he divorced his wife so as to consecrate himself solely and wholly to science. "I shall not remarry," he exclaimed. Nevertheless he took another wife soon afterwards. The first wife was unaware of this, for he continued to visit her every evening during a period of seven years.

[6] Personal communication.

obsequies have been performed, Glozel refuses to remain in its sepulcher, and the literary battle continues. Dr. Morlet very kindly sends me newspapers and pamphlets, and a distinguished pro-Glozelian of Belgium, Professor Tricot-Royer, has just supplied me with his defense of Glozel which is particularly interesting because Professor Tricot-Royer was present during the visit of the international commission.

What keeps Glozel alive? First, we have the fact that when men take sides in print they are loath to recant, fearing ridicule—the more untenable their position, the more stubborn their resistance.

Secondly, six months after the international commission's visit Dr. Morlet called together a *comité d'études* of twelve men, consisting of Dr. Foat, Bayet and Tricot-Royer, of Belgium; Reinach, J. Loth, W. Loth, Van Gennep, Deperet, Ajcelin, Roman and Audollent, of France, and Soderman, of Sweden. At their meeting they pronounced unanimously in favor of the genuineness of Glozel.

Another reason is found in the attitude of a group of French and German scientists who are opposed to the traditional belief that *ex oriente lux*—that civilization is of oriental origin. The alleged Neolithic alphabet of Glozel and similar finds at Alvao in Portugal are grist to their mill.

In addition quasi-political factors have entered into the controversy—Fradin an obscure peasant, Morlet a provincial doctor without much influence have a definite appeal for the proletariat and for a large section of the press.

And finally, it must be remembered that the Academicians are not always right—that they ridiculed Pasteur and Boucher des Perthes, and that even Koch and Lister met a similar fate in the beginning.[7]

All these elements cooperate to keep the spark of life in Glozel. Within the past few weeks the publication of an exhaustive treatise by Dr. Morlet has been announced. This, however, I fear, can throw no new light upon the subject.

As a detective tale the story of Glozel remains unfinished and will remain so until a Sherlock Holmes discovers the supposed person or persons who manufactured the articles and put them in the ground. What was the motive? How are we to explain the extraordinary industry that has fashioned five thousand or more articles, and how is it that he, the *esprit de Glozel,* escaped detection in a community of twenty-nine souls where every one knows every one else's business? Or how, if there are witnesses to the dark deed, can we explain an unbroken neighborly silence extending over a period of six exciting years?

PREPARATION OF SCIENTIFIC ARTICLES

By W. M. DAVIS

PROFESSOR OF GEOLOGY, EMERITUS, HARVARD UNIVERSITY

RECOLLECTIONS of many untrained efforts and of many changes in methods of writing scientific articles prompt me to set down some of the more profitable results of a rather long experience in that sort of work, in the hope that they may prove useful to others.

THE ARTICLE

After the subject of an article has taken shape in the mind and the general sequence of its headings has been planned, cut some typewriter paper in half and write brief statements of the leading points on separate half pages. Never begin a second paragraph on the same page with the end of the preceding one. Do not hesitate too long over the precise wording of this first draft; set ideas down as they take form; revise, clarify and compress the wording afterwards. Arrange the pages in a logical order, number them 5, 10, 15, 20, and so on, and make out a provisional table of contents. Changes and additions which require the rewriting of paragraphs and the later insertion of afterthoughts with intermediate paging are thus much facilitated.

Carry a blank book with the growing manuscript —an examination blue-book will serve—and keep a record of work done on its first pages. Besides mention of whatever occurrences led up to the preparation of the article and notes on the incidents of its progress, the following dates should be entered: Beginning and ending of the rough draft; making first clean copy, and second also if a second prove necessary; sending copy to the publisher and acknowledgment of its receipt; arrival and return of galley proof and page proof; appearance of article; receipt and distribution of reprints. The more significant of these notes and dates should be later copied off in good form and pasted, with a list of correspondents to whom reprints are sent, in the reprint kept in one's own file. Much do I regret not having such a

[7] Recently the Geological Society of Normandy (*Mercure de France,* April 15, 1930) has formally proffered "ses plus vives félicitations" to Dr. Morlet for his science, his tenacity and above all for the magnificent energy with which he has faced the attacks and unjust calumnies to which he has been subjected and which the Court of Appeals at Riom has definitely condemned.

set of records, one for each reprint on my personal book-shelf.

On later pages of the same blank book enter all questions which arise during composition or revision of the manuscript and for which answers have to be searched in various sources. Both questions and answers should be written out rather fully, so as to avoid misunderstandings and errors. Do not trust to scraps of paper for these memoranda; enter them all, both questions and answers, in the blank book in orderly form. If scraps are used much time is lost in re-search in case they are accidentally mislaid.

When the time comes for making the first clean copy of the apparently completed manuscript, examine the periodical to the editor of which the article is to be offered for publication, and thus learn the form in which "copy" should be prepared for its pages; for example, whether a summary or a table of contents should be inserted at the beginning; whether references should be made by star and dagger signs, by numbers to numbered foot-notes, by numbers to a numbered bibliographic list at the end of the article, or otherwise. Then prepare the rough manuscript accordingly for clean copy on full-sized sheets, and the editor will be grateful. My own preference as to references is to place a list of all articles cited, arranged alphabetically by author's names, at the end of the manuscript; and when an author's name or a citation of his writings appears in the text, add a parenthesis containing the year in which his article was published and the page on which the cited passage is found. This avoids the repetition of a title in successive foot-notes when the same article is referred to several times, and also does away with those inconvenient abbreviations, *loc. cit.* and *op. cit.*

Faults of style and arrangement that passed unnoticed in a first rough draft often become rather glaringly visible in a clean copy, and it therefore soon becomes more or less disfigured with erasures and interlinings. As clearness of text is more important than elegance of appearance, it usually suffices to typewrite the disfigured parts in close lines on narrow strips and paste them over the disfigurement; a good deal of unnecessary copying is thus saved. When this stage of improvement is reached, it is a good plan to lay the article aside for a week or a fortnight, and then read it aloud to some patient listener. The main thing to consider at this time is whether the style is as concise as possible and whether the subject has been presented in such a manner that a reader not familiar with its details can comprehend it. His honorable points of ignorance must be carefully enlightened, and a listener is likely to be helpful in showing where enlightening suggestions are needed. So many improving changes may be thus made, especially if the article is argumentative, that a second clean copy has to be prepared. This causes some delay which an enthusiastic author may not enjoy; but the world will have already waited so long for his article that a little longer waiting will not cause wide-spread discontent.

BIBLIOGRAPHY

Whenever a book or article is consulted and an extract is made from it, enter the name of the author, title of the article and its source, as well as all abstracts and quotations with their pages, on a slip about the size of a postal card (several slips may be needed for long excerpts). Then compare every word with the original; if found correct make a nick (√) opposite name, title, source and each quotation. When final clean copy is made and when proof is received, compare all citations with these authenticated slips and thus save many hours of fatiguing labor that would otherwise be demanded by returns to the original sources for verification. If an author has two initials before his family name, they suffice to identify him; if only one, his first name should be given. Thus, J. B. Hazelton, but Thomas Simonds. If a book is consulted, its place and year of publication should be noted.

It would be a good thing if the National Research Council would propose a standard form for bibliographic references; and if they do so I beg leave to suggest that they recommend Arabic numerals for volume numbers, omit parentheses enclosing dates and discard Vol. and pp. Thus if the abbreviated name of a periodical is followed by the figures 38, 1924, 263–279, no uncertainty can be felt as to their meaning. The first number, 38, can mean only the volume; the second, only the date of publication, and the last two numbers, only the first and last pages of the article cited. In case Vol. and pp. are retained, why not insert A. D. before the date and use Roman numerals for the volume? Then the same reference would read: Vol. XXXVIII, A. D. 1924, pp. 263–279, and would occupy almost double the space of the more condensed reference. If a periodical groups its volumes into successive series, the number of the series need not be quoted, because the year suffices to indicate the volume intended. But until a standard form for references is introduced and adopted, the style of references used in the publication of the author's choice should be followed.

Professional bibliographers and library cataloguers are of course expected to transcribe the entire title of an article or book, however long it may be; but a scientific author may be excused if he condenses an overlong title to a reasonable shortness, the omitted parts being indicated by dots. I do not know how

others feel about it, but my patience is always tried by titles of twenty words or more. Here are two samples, paraphrased from actual titles: "Outline of the mountain forms on the south coast of Labrador, with special attention to the littoral outcrops of Devonian strata"; and "Preliminary notes on the geology of the Marquesas Islands, with particular consideration of the Mehetian and Paumotuan dolomites." They might be advantageously reduced to "Mountain forms in southern Labrador" and "Geology of the Marquesas Islands." If an author regards further details as indispensable, let him show consideration for those who wish to cite his work by dividing its title into a main and a subordinate heading; for example, "The south coast of Labrador, with an outline of its mountain forms and an account of littoral Devonian outcrops." Then only the first five words need be quoted; a few dots will show that more title follows, unquoted. But if an author thus condenses the title of other writers' articles, let him take care to compress the title of his own articles into the fewest possible words. A title should not be a table of contents but only a concise name, easily cited. On the other hand, it should not omit essential words; for example, "Fossils of the Dobreva formation" is not so intelligible as "Lower Triassic (Dobreva) fossils from Nevada."

Condensation of unreasonably long names of periodicals is also advisable, if for no other reason than to persuade their editors to adopt shorter names. Why, for example, can not the University of California be satisfied to have its excellent geological bulletin referred to as "Univ. Calif. Geol. Bull." instead of asking that it should be cited as "Univ. Calif. Publ. Bull. Dept. Geol. Sci." The fact that the bulletin is published by the department of geology—if such be the case—is merely a local administrative detail, of little or no interest in geological science. The complete title is, indeed, so long that it has to be abbreviated in its own page headings, and even the graduates who contribute to it do not always cite it correctly! And yet six of the abbreviated words are dutifully cited in the invaluable Bibliography of American Geology, published as Bulletin 746 of the U. S. Geological Survey, which otherwise carries abbreviation to its farthest reach; B means Bulletin; J, Journal; Ac, Academy; Am, American; Pr, Proceedings; Sc, Science, and so on.

Quotations between inverted commas should follow the original passage with scrupulous care, even to the point of reproducing incorrect spelling. Omissions from quoted passages should be indicated by dots; additions to them should be enclosed in square brackets.

ILLUSTRATIONS

When it comes to the preparation of illustrations, cut a rectangle of paper the size of a page in the selected journal of publication, and trace on it the outline of the space given to the printed text. Illustrations should then be drawn so as to fit that space, which is generally narrower than it is imagined to be. Whatever the height of a figure, its width should as a rule be that of the printed page, like Fig. 1, *A*. If smaller it should be only about half as wide, like *E*, so as to leave sufficient room for text alongside of it. If an extra-long figure is needed, it may be drawn in two halves, to be set opposite each other

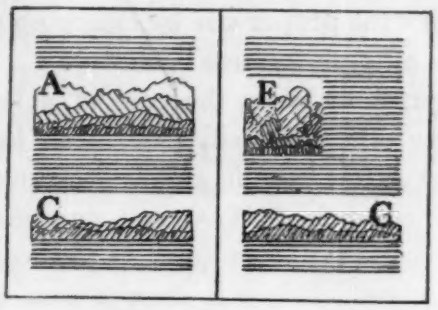


FIG. 1

on facing pages, like *C, C*, each half being as wide as the printed page—always provided the editor will permit so unconventional an innovation.

In order to know which one of the above sizes is best for an illustration, outline it roughly on as small a scale as it will bear. Then draw a rectangular frame around it of the size selected. From this construct a pencil frame two or three times as large on smooth, hard-surfaced paper, and outline the drawing carefully in pencil in the space thus defined. Omit unnecessary marginal lines, in order that the essential part of the drawing may be on as large a scale as possible. Set the outline aside for a day or two, so that on coming back to it with refreshed eyes it may be critically examined and improved before it is finished in smooth, firm, jet-black ink-lines with a fine pen. The frame also may be inked with a ruling pen if desired. Do not ink any lines so close together that the narrow white space between them will be blurred or lost when the drawing is photographically reduced to smaller scale in a process cut.

If a mistake is made in inking, do not erase it, but first rub out all near-by pencil lines, then paste a slip of opaque white paper over the mistake, and correct it after the slip is well dried. Be careful that the paste does not overrun the edge of the slip; if it does, ink lines will blot there. In pasting the slip on the drawing, lay a cover-paper over it and rub down the cover paper, not the slip. If explanatory letters are needed on the drawing, take from the waste-

basket an advertising pamphlet; cut from it plain capitals of sufficient size—they need not be A, B, C, D; any other letters will do as well; and paste the letters on the drawing. Erasure of pencil lines before pasting is advisable, because if a pencil line is accidentally covered by paste, it can hardly be erased. Do not guess at the size the letters should be; find some journal in which the illustrations are satisfactorily lettered, and enlarge the height of the letters as much as the drawing frame was enlarged; then search for letters as nearly as possible of that enlarged height. If names must be added, print them in unshaded Roman letters, BbRrKk, without serifs. Here again, do not guess at the size of the letters, but determine the proper size by enlarging good hand-printing on a figure in some book.

Do not print or write the title of a figure inside of its frame; the title will look much better if set up in type below the figure and printed with it. When a drawing is finished and unnecessary blank paper is trimmed off, paste it at the corners on a blank half sheet. Below it draw a line, crossed like a T at its ends, to show the width to which the drawing is to be photographically reduced. Below this line write the title of the figure and any explanatory legend that is to be printed with the title. Wait until the final copy of an article is about to go to the publisher before numbering the figures and inserting the numbers in the text. Then add to the half-sheets which carry the drawings the figure numbers and the number of the manuscript page where each figure belongs. Finally, write out a list of the figures with their numbers and titles and add the list to the clean copy of the manuscript. If it is proposed to have photographs reproduced in half-tone illustrations, be sure that they are worth reproducing. Many poor photographic views have been undeservedly immortalized in recent years of inexpert Kodakery. Better than a poor photograph is an outline neatly traced from it.

If a book is contemplated, the larger it is to be the more all the above suggestions or their equivalents should be emphasized. The record book, the orderly listing of all questions in it for which answers have to be looked up, the careful authentication of titles and quotations, the adjustment of illustrations to pages, all gain greater and greater importance as the size of the book increases. The advice but not the dictation of an experienced publisher regarding the form and style of the book is valuable; and this advice should be sought early, in order that the work done in composition and illustration should be properly directed toward its goal.

When galley proof is received, indicate the position desired for each illustration on the margin. If page proof is seen later, some figures may be found on the back of the page that carries their text. It is then desirable to rearrange the text if possible by shifting paragraphs so as to bring the figure and its explanation together. If an order for reprints is given, be sure to request that the pages of the reprints be neither rearranged nor renumbered; the reprints should be exact duplicates of the article as originally paged and printed. If a cover is ordered it should bear the title of the article and the author's name, and the name of the journal of publication, with its volume and year, and the first and last pages of the article. It is desirable that the author's address should also be given, for it is very likely unknown to some of those to whom reprints are sent.

The plan of work outlined above may be called methodical; and some writers, deeming themselves unmethodical, may regard the plan as too systematic for their adoption. Yet it is particularly to such writers that the plan is submitted, for I began unsystematically myself and long failed to form orderly habits of work—in consequence of which I have had to retrace many steps and reopen many books needlessly. A little patient practice on the plan here set forth or on some other consistent plan can not fail to be serviceable to many a young scientist in reducing accidental and more or less disorderly habits of work to more orderly and time-saving habits. The use of half-sheets is a very helpful device, especially in the early stages of composition; the addition of authenticating nicks on reference slips, soon becoming habitual, will save hours and days in verifying quotations. One more suggestion in closing: condense all manuscripts as much as is reasonably possible.

OBITUARY

RECENT DEATHS

DR. JAMES MORFORD TAYLOR, professor emeritus at Colgate University, where he held a professorship of mathematics from 1873 to 1920, died on July 31 at the age of eighty-six years.

DR. HENRY W. HENSHAW, formerly chief of the U. S. Biological Survey, died at Washington on August 1 at the age of eighty years.

PROFESSOR ALLVAR GULLSTRAND, professor of physiological optics at the University of Upsala, who received the Nobel prize for medicine in 1911, died on July 27. He was sixty-eight years old.

GLENN H. CURTISS, the widely known aviation pioneer, died on July 23.

THE death at the age of sixty-three years is reported of Dr. Wyatt William Randall, chief of the bureau of chemistry of the Maryland Department of Health and associate in chemistry in the School of Hygiene and Public Health of the Johns Hopkins University.

DR. ARTHUR A. LAW, one of the founders of the American College of Surgeons and for many years a professor in the department of surgery of the University of Minnesota, died on July 9 at the age of fifty-eight years.

DR. CHARLES CHANNING ALLEN, dean emeritus of the Kansas City Western Dental College, died on July 15.

WILLIAM HENRY BRISTOL, president of the Bristol Company at Waterbury, Connecticut, known as the manufacturer of recording instruments and as the inventor of the Bristolphone, an instrument which synchronized sound and action in motion pictures, died in June at the age of seventy-one years.

MEMORIALS

A DISPATCH from Oslo reports that a ceremony took place recently at the monument of Niels Henrik Abel, the great mathematician, when the Italian mathematicians paid him homage through Dr. Bruno de Mori. The Italian legation, the University of Oslo, Norwegian mathematicians and the government were represented.

A MEETING in honor of the late Dr. Fridtjof Nansen held on July 14 at the Royal Society of Arts was addressed by Lord Cecil, Mr. P. N. Baker, Mr. Cunninghame Graham, the Norwegian minister and others. The chair was taken by Mr. J. Howard Whitehouse, chairman of the commmittee for the preservation of the *Fram*.

THE *Journal* of the American Medical Association states that "fellows and friends of the London School of Tropical Medicine have subscribed more than £6,000 toward the establishment of a memorial home for the school which Sir Patrick Manson founded and where he taught for twenty years. To further this tribute to the father of modern tropical medicine, the fellows have sent out a general appeal for £20,000 in the belief that many individuals outside of the small professional circle of tropical medicine will help. Donations may be sent to Dr. George Carmichael Low, the Royal Society of Tropical Medicine and Hygiene, 11 Chandos Street, Cavendish Square, London, W. 1."

SCIENTIFIC EVENTS

SCIENCE SERVICE RADIO TALKS

THROUGH the courtesy of the Columbia Broadcasting System in placing a weekly fifteen-minute period at its disposal, Science Service has been presenting a radio talk by a prominent scientist every Friday afternoon at 3:45 p.m., Eastern Time. These began on Friday, March 28, with a talk by Dr. Warren S. Thompson, director of the Scripps Foundation for Research in Population Problems, on "Our Future Population." They are presented through a network of thirty to forty broadcasting stations covering the country from coast to coast.

Other speakers in the series to date have been: Dr. Paul Heyl, U. S. Bureau of Standards; Dean Edward W. Berry, the Johns Hopkins University; Dr. Charles G. Abbot, secretary, Smithsonian Institution; Dr. Harlan T. Stetson, director, Perkins Observatory, Ohio Wesleyan University; Dr. Ray Lyman Wilbur, president of Stanford University and Secretary of the Interior; Dr. Walter V. Bingham, director, Personnel Research Federation; Dr. John C. Merriam, president, Carnegie Institution of Washington; Sir William Bragg, director, Royal Institution of Great Britain; Dr. A. C. Lane, professor of geology, Tufts College; Dr. Fay-Cooper Cole, professor of anthropology, University of Chicago; Dr. Kirtley F. Mather, chairman, department of geology and geography, Harvard University; Dr. Frank E. Lutz, curator of entomology, American Museum of Natural History; Mr. H. N. Eaton, physicist, U. S. Bureau of Standards; Dr. Samuel A. Mitchell, director, Leander McCormick Observatory, University of Virginia, and Dr. Knight Dunlap, professor of experimental psychology, the Johns Hopkins University. All the talks are arranged by Mr. James Stokley, of the editorial staff of Science Service, under the general direction of Watson Davis.

For the months of August and September, Science Service has announced the following program.

August 1. Dr. Charles P. Olivier, director of the Flower Observatory of the University of Pennsylvania—"The August Meteors."

August 8. Dr. W. J. Humphreys, professor of meteorological physics, U. S. Weather Bureau—"Weather and Aviation."

August 15. Mr. H. N. Wheeler, U. S. Forest Service—"Fighting Forest Fires."

August 22. Dr. John M. Arthur, Boyce Thompson

Institute for Plant Research—"Light and Green Plants."

August 29. Dr. William A. White, Superintendent, St. Elizabeth's Hospital—"Mental Hygiene."

September 5. Mr. Charles L. Mitchell, principal meteorologist and district forecaster, U. S. Weather Bureau—"Tropical Hurricanes."

September 12. Mr. Watson Davis, managing editor, Science Service, Inc.—"Industrial Revolutions."

September 19. Dr. A. F. Blakeslee, assistant director, Station for Experimental Evolution of the Carnegie Institution of Washington—"Heredity and Environment."

September 26. Dr. Paul G. Redington, chief, Bureau of Biological Survey, U. S. Department of Agriculture—"Uncle Sam Watches his Animals."

The talks are given at 3:45 p. m., Eastern Daylight Saving Time, while such time is in effect. After that they will be given at 3:45 p. m., Eastern Standard Time. They are presented from the Columbia studios in New York City, Philadelphia, Washington or Atlantic City.

PLANS OF THE SCRIPPS INSTITUTION FOR COOPERATION WITH EASTERN AGENCIES

COOPERATION by the Scripps Institution of Oceanography of the University of California with several eastern organizations has been arranged by Dr. G. F. McEwen, of the institution staff, who has recently returned from Washington and other cities in the East, according to announcement by Director T. Wayland Vaughan. Dr. McEwen made the trip to the Atlantic coast on business connected with preparation of reports on hydrographic observations made by the Carnegie Institution of Washington on the recent cruise of the non-magnetic ship *Carnegie*, and with the development and extension of the work on marine meteorology and weather forecasting by the Scripps Institution.

In the course of this trip a number of preliminary or provisional plans were discussed for closer cooperation between the Scripps Institution and several eastern organizations already active in related work. At Toronto, Ontario, Director J. Patterson, of the Canadian Meteorological Service, agreed to tentative plans for giving the Scripps Institution the use of thermograph records being obtained by four Canadian Pacific liners in regular service across the North Pacific. Each of these ships has a thermograph giving a continuous record of condenser-intake temperatures encountered from port to port.

At Clark University Dr. McEwen had a conference with Dr. C. F. Brooks, meteorologist, in which possibilities of cooperation in use of records and observations was discussed. At the office of the United States Weather Bureau in Washington arrangements with Mr. F. G. Tingley were practically completed, whereby copies of sea surface temperatures, winds and barometric pressures taken by ships will be made from the Scripps Institution to use in its work of forecasting rainfall in California. Similar arrangements were made with Mr. A. B. McManus in charge of the hydrographic records of the hydrographic office of the United States navy, by which copies of records of sea surface temperatures and of wind movements will be available for use by the Scripps Institution in its work of forecasting.

THE FOURTH GREENLAND EXPEDITION OF THE UNIVERSITY OF MICHIGAN

LARGELY as a result of the recently announced plans of the British Arctic Air Route Expedition, which is to be based on Angmagssalik in East Greenland, the plans of the Fourth Greenland Expedition of the University of Michigan have been somewhat modified.

The "eastern" party under Carlson instead of basing on Angmagssalik will be located near Upernivik in northwest Greenland. This party consisting of William S. Carlson and his assistant, Max Demorest, sailed July 31 on the Canadian Government steamship *Beothic* from North Sydney, Nova Scotia, direct to Godhavn in North Greenland, from which point it will later proceed to Upernivik on the Danish motorship *Disko*.

This party has material for construction of a house and is provisioned for one year's stay. It is equipped for carrying out upper-air studies, and pilot balloons will be sent up on all fair days for study of the atmospheric circulation. The front of the Cornell Glacier, one hundred and twenty-five miles north of Upernivik, which was surveyed by Tarr's Cornell Expedition more than thirty years ago, will be re-surveyed by Carlson. Dog sled expeditions over the inland-ice will be made by Carlson and special glacial studies carried out.

Evans S. Schmeling, conducting the southern party, will, as already stated, sail from Philadelphia for Ivigtut in extreme south Greenland August 13 on the ore freighter *Wagland* chartered by the Pennsylvania Salt Manufacturing Company of Philadelphia. Schmeling will carry out similar upper-air and glacial observations to those at the north station. The little settlements of Upernivik and Ivigtut are, respectively, about four hundred and fifty miles north and four hundred and fifty miles south of the Mount

Evans Station, the base of the second and third expeditions of the university.

The first volume of the technical reports on the earlier expeditions, which is devoted to aerology and edited by S. P. Fergusson, of the U. S. Weather Bureau, is now complete and ready for printing.

THE INTERNATIONAL CONFERENCE OF AGRICULTURAL ECONOMISTS

DELEGATES to the International Conference of Agricultural Economists will meet at Cornell University from August 18 to 29. Delegates from England, Ireland, Australia, Germany, Poland, Finland, Russia and other European countries and from China and Japan arrived in New York on July 27, spending four days in an inspection and sight-seeing tour of the city. Delegates to the conference from abroad include:

George Dallas, M. P., London, England; Miss Persia Campbell, Melbourne, Australia; Kuro Koboyokawa, Tokio, Japan; A. Bridges, Oxford; O. Vopelius, University of Berlin; B. Duncan, Scottish Farm Servants' Union, Sterling; T. Whittaker, University of Edinburgh; Price Howell, Aberystwith; D. E. Harkness, Minister of Agriculture, Belfast; K. T. Jutila, University of Helsingsfors; J. E. Latimer, McDonald College, Quebec; A. Jones, Minton Agricultural College, Sutton Bonington, England; E. Thomas, University of Reading; D. H. Dinsdale, Armstrong College, Newcastle-on-Tyne; C. B. Daw, University of Bristol; F. J. Pruitt, University College, Aberystwith.

F. M. Secay, University of the Philippines, Los Banos; W. Allen, University of Saskatchewan; R. W. Enfield, assistant secretary of agriculture, London; E. M. H. Lloyd, Empire Marketing Board, London; F. E. Geldenhuys, assistant secretary of agriculture, Pretoria; S. Schmidt, University of Cracow, Poland; R. M. Campbell, University of New Zealand; A. Schmindler, Berlin; E. Jensen, Copenhagen; L. K. Elmhurst, Totnes, England; A. W. Ashley, Aberystwith; M. Sering, University of Berlin.

A. N. Duckham, Aberdeen; J. J. W. Seedorf, Göttingen; H. Zoerner, University of Berlin; K. Brandt, University of Berlin; H. von Dietze, University of Jena; L. Feisch, Berlin; A. G. Ruston, University of Leeds; J. King, Edinburgh; Paul Hsu, University of Nanking; J. P. Maxton, Oxford; G. M. Dykes, London; A. A. Buotinkov, Ukranian Agricultural College, Kharkiv, Ukraine; Professors Vavilov, Anisimov, Geister, Goerdieff, Moscow Agricultural Academy.

THE BRITISH MEDICAL ASSOCIATION

THE annual meeting of the British Medical Association this year is to be held in two parts. The first, the annual representative meeting, which discussed policy and internal business, was held in the Great Hall of the British Medical Association House, London, from July 18 to 22, inclusive. The second, the scientific and social part, will be held at Winnipeg from August 25 to 29, inclusive.

The annual representative meeting was presided over by its chairman, Dr. C. O. Hawthorne, of London. According to the London *Times* on the first day there was a discussion on a recommendation of the council of the association "that the time is now ripe for the medical profession to ask for the inclusion under the National Health Insurance Service of the dependents of insured persons."

Under the head of "Medical Ethics" the question of whether a medical practitioner who makes an invention or discovery in the medical field should derive financial benefit from a patent or from royalties was discussed.

Another discussion was under the recommendation of the council that where advice on birth control is given at any maternity or child welfare center, it should be given on medical grounds only, and at the discretion of the medical officer, and not merely because it is asked for by the patient.

On July 19 there was a discussion on the hospital policy of the association, a matter of considerable complexity, having regard to the new position caused by the taking over of the old Poor Law hospitals by the county and county borough councils and the increasing number of contributory schemes throughout the country. This was followed by a discussion on the general medical service proposals of the council, which are in the nature of a contribution to the discussion whether the medical service of Great Britain shall develop as a service, becoming more and more officialized, or as one which, while making available everything medical that any member of the community requires, shall retain so far as possible the independence of the medical profession and the right of the patient to choose his or her own doctor.

The formal annual general meeting was held on July 22, when the president (Professor A. H. Burgess, F.R.C.S., of Manchester) gave place to the incoming president. Professor Harvey Smith, of Winnipeg, was not present, but the president-elect for 1931, Dr. W. G. Willoughby, medical officer of health for Eastbourne, was introduced.

That part of the annual meeting which follows at Winnipeg is divided into 14 sections, of which all the presidents are as follows:

Medicine, Lord Dawson of Penn; Surgery, Lord Moynihan of Leeds; Obstetrics and Gynecology, Mr. Comyns Berkeley (London); Bacteriology, Pathology, Physiology and Bio-Chemistry, Professor Robert Muir (Glasgow); Diseases of Children, Dr. Robert Hutchison (London); Mental Diseases and Neurology, Sir Farquhar Buzzard, Bt. (Oxford); Ophthalmology, Mr. N.

Bishop Harman (London); Laryngology and Otology, Sir St. Clair Thomson (London); Preventive Medicine, Dr. A. S. M. Macgregor (Glasgow); Tuberculosis, Professor A. Lyle Cummins (Cardiff); Radiology, Dr. A. E. Barclay (Cambridge); Medical Sociology and History of Medicine, Dr. J. D. Comrie (Edinburgh); Anesthesia, Dr. R. E. Apperly (London); Orthopedics, Mr. Laming Evans (London).

SCIENTIFIC NOTES AND NEWS

DR. F. O. BOWER, emeritus professor of botany at the University of Glasgow, who succeeds Sir Thomas Holland as president of the British Association for the Advancement of Science, has taken as the subject of his address "Size and Form in Plants." The meeting of the association is at Bristol from September 3 to 10.

PROFESSOR PAOLO ENRIQUES, director of the institute of zoology, comparative anatomy and physiology in the University of Padua, will preside over the International Zoological Congress which will hold its eleventh session in Padua from September 4 to 11.

THE Lister Memorial Lecture before the Royal College of Surgeons of England was delivered by Dr. Harvey Cushing, professor of surgery, Harvard Medical School, on July 9 on "Neuro-hypophysial Mechanisms from a Clinical Standpoint." On this occasion the Lister Medal was presented to Dr. Cushing.

PROFESSOR MARTIN HAHN, director of the National Hygiene Institute of Berlin, was elected president of the International Association of Microbiology at the recent meeting in Paris. Sir Almroth Wright was elected honorary president. Among Americans attending the congress were Dr. Alexis Carrel, of the Rockefeller Institute for Medical Research, and Dr. William Hallock Park, director of the New York Health Department Bureau of Laboratories.

DR. LEONHARD STEJNEGER, head curator of biology at the National Museum, and Dr. Charles W. Stiles, chief of the division of zoology of the Public Health Service and custodian of the helminthological collections of the U. S. National Museum, have been appointed delegates from the United States Government to the eleventh International Congress of Zoology to be held in Padua next month.

AT a recent election of the American Institute of Electrical Engineers, William S. Lee, consulting engineer, Charlotte, N. C., was made president of the institute for the year, beginning August 1. Other officers elected were: *Vice-presidents,* I. E. Moultrop, Boston, and H. P. Charlesworth, New York; T. N. Lacy, Detroit; G. C. Shaad, Lawrence, Kansas, and H. V. Carpenter, Pullman, Washington; *Directors,* A. B. Cooper, Toronto, Ont.; A. E. Knowlton, New York, and R. H. Tapscott, New York; *Treasurer,* George A. Hamilton, Elizabeth, N. J. (reelected).

NEW officers elected at the recent meeting of the American Society of Clinical Pathologists are: *President,* Dr. Kenneth M. Lynch, Charleston, South Carolina; *President-elect,* Dr. H. J. Corper, Denver, Colorado; *Vice-president,* Dr. Clarence I. Owen, Detroit, Michigan, and *Secretary-treasurer,* Dr. A. S. Giordano, South Bend, Indiana.

AT the recent meeting in Detroit of the American Medical Association gold medals were awarded to Professors Frederick G. Novy and Malcolm H. Soule, of the University of Michigan, for "excellence of presentation of studies on respiration and dissociation of micro-organisms."

PROFESSOR HOWARD E. SIMPSON, of the department of geology of the University of North Dakota and state water geologist, received the honorary degree of doctor of science at the commencement exercises of Cornell College, Mount Vernon, Iowa, his Alma Mater.

DR. KURT HERBST, professor of experimental embryology at the University of Heidelberg, and Dr. Kasimir Fajans, professor of physical chemistry at the University of Munich, have been elected members of the Polish Academy of Sciences at Krakau.

THE Messel Medal, awarded for services to the chemical industry, was presented to Lord Brotherton on July 18 at the forty-ninth annual meeting of the Society of Chemical Industry at Birmingham. The late Lord Balfour and the late Lord Leverhulme were previous recipients of the medal. In making the presentation, the retiring president, Dr. Herbert Levinstein, said it was the fashion now-a-days, in some circles, to consider it a crime for a man to be successful in industry. "We do not share that view," he added. "We are bestowing this medal upon Lord Brotherton chiefly because from small beginnings, by enterprise, by courage, by great industry and by the force of his personality he has built up one of the most successful chemical industries in the country." After acknowledging the presentation, Lord Brotherton delivered the fifth Messel Lecture, entitled "Fifty Years in the Chemical Industry."

THE council of the University of Manchester has

unanimously adopted a resolution paying tribute to the work of Professor F. E. Weiss, on the occasion of his retirement from the George Harrison chair of botany, which he has held since 1892, expressing their gratitude to him "for the outstanding services which he has rendered to the university."

THE title of emeritus professor of physics in the University of London has been conferred on Professor C. H. Lees on his retirement from East London College.

AT the Ohio State University the following appointments have been made in the department of physics: Professor Alfred Landé, of the University of Tübingen, professor of theoretical physics; Dr. L. H. Thomas, of Trinity College, associate professor of theoretical physics, and Dr. H. H. Nielsen and Dr. W. H. Bennett, instructors in physics.

DR. GEORGE T. HARGITT, professor of zoology at Syracuse University, has been appointed graduate professor of zoology at Duke University.

DR. JOHN RENNIE has been appointed professor of public health in the University of Sheffield in place of the late Professor F. E. Wynne. Dr. Rennie is medical officer of the City of Sheffield.

DR. P. W. GREGORY, of Baker University, has joined the staff of the University of California at the Davis Branch of the College of Agriculture as geneticist in the division of animal husbandry.

JOHN A. C. WARNER, of the Studebaker Corporation, has been appointed secretary and general manager of the Society of Automotive Engineers to succeed the late Coker F. Clarkson, the only previous incumbent of the position, who had held it for the past twenty years.

PERRY A. DAVISON, George F. Taylor, William S. Pike, Jr., and Charles F. Park, Jr., have been appointed junior geologists in the U. S. Geological Survey.

DR. J. L. BYRD, formerly health officer of Colon, has been appointed health officer of Panama City, to fill the vacancy caused by the death of the late Dr. Paul Preble.

DR. ROBERT CUNNINGHAM MILLER, of the University of Washington, visiting professor of biology in Lingnan University, Canton, China, is conducting a survey of the marine wood-boring organisms of the coast of China. The project is being financed jointly by Lingnan University and the Rockefeller Foundation. The cooperation has been secured of the Chinese Maritime Customs.

DR. R. J. LANG, associate professor of physics in the University of Alberta, at Edmonton, Canada, will spend next year in research work at the Physical "Reichsanstalt," Berlin.

PROFESSOR WILLIAM B. HERMS, professor of parasitology at the University of California, gave an illustrated lecture at the Franz Theodore Stone Laboratory of the Ohio State University, at Gibraltar Island, Put-in-Bay, Ohio, on the evening of July 25. His lecture dealt mainly with the fauna and flora of certain typical coral atolls of the Mid-Pacific Ocean. Professor Herms is a visiting professor at the Ohio State University during the summer quarter.

THE Association of American State Geologists, composed of chief geologists in forty-one states, will hold its annual field conference in Wyoming and Montana from August 24 to 29, according to a statement issued by the Wyoming State Geologist, John G. Marzel. The conference will assemble in Glacier National Park and thence proceed to Butte, at which mining center the annual business sessions will be held on August 25 and 26. Following this a tour will be made of Yellowstone Park.

THE opening of the International Electro-Technical Congress took place in Copenhagen, although the various conferences are to be held in Stockholm. This was due to many of the delegates desiring to honor Hans Christian Orsted, formerly professor of natural philosophy in the University of Copenhagen, known for his researches in electromagnetism. Visitors from Austria, Germany, Belgium, Brazil, Canada, France, the United States, Holland, England, Norway, Poland, Switzerland, Greece, India, Japan, Rumania, Czechoslovakia and Soviet Russia visited Orsted's statue, and were entertained in Copenhagen.

MR. GEORGE EASTMAN has given $1,000,000 to the Italian Government for the erection of a clinic and college in Rome.

ACCORDING to the German press the Rockefeller Foundation has given $375,000 for a new building for the research division of the zoological institute of the University of Munich under the directorship of Professor Dr. K. von Frisch, and for the institute of physical chemistry under the directorship of Professor Dr. Kasimir Fajans. A grant of $675,000 is said to have been made from the foundation for the Kaiser Wilhelm Society in Berlin, which since its foundation in 1911 has grouped round it a dozen institutes for the promotion of science. The grant is especially made for the purpose of providing Professor Max von Laue and Professor Otto Warburg with institutes for their work.

THE Max Pam Metabolic Unit for Clinical Research in diseases of metabolism was opened on July 21 at the Michael Reese Hospital, Chicago. A capital fund

of $150,000 is provided for the maintenance of this unit, which is equipped for the investigation of metabolic diseases along physiological and chemical lines. It will be conducted in cooperation with departments of the Nelson Morris Institute of Research, which is a part of the Michael Reese group.

MR. EDO NICOLAUS CLAASEN, of Cleveland, has given his private collection of ten thousand botanical specimens to the department of biology of Western Reserve University.

MR. H. EARLE RUSSELL, United States Consul, Alexandria, Egypt, reports to the *U. S. Daily* that the Egyptian ministry of agriculture has decided to create at Cairo an agricultural museum, costing about $1,000,000, and to invite the director of the Budapest Agricultural Museum to go to Egypt to undertake the organization of the museum. The Egyptian Royal Agricultural Society has decided to hold a general agricultural and industrial exhibition on its grounds at Ghexireh, near Cairo, in February, 1931. The society has requested the Egyptian premier that it may receive assistance from all the government departments that aided in the 1926 exhibition. These included the participation of the ministry of agriculture, the state domains, the survey administration and the schools of the ministry of education; the ministry of communications which reduced by 70 per cent. the fares of passengers going to Cairo for the exhibition and the freight rates on livestock and articles for exhibition purposes, and the administration of posts, telegraphs and telephones, which set up offices inside the exhibition grounds. They also included the department of commerce and industry which encouraged industrial establishments to take part; the prisons administration, which exhibited the works of prisoners; the governors and mudirs, who made propaganda in their respective provinces; the ministry of public works which helped in the construction of buildings, roads and gardens for the exposition, and the frontiers administration which organized a special section showing the habits of the bedouins and their modes of life.

THE thirty-ninth annual report of the council of the British Institution of Mining and Metallurgy records, as reported in *Nature*, the following awards which were presented at the annual general meeting on June 26. The gold medal of the institution to Sir Thomas H. Holland, in recognition of his distinguished services to geological science and to the mineral industries during his tenure of high public appointments—notably those of director of the Geological Survey of India and of rector of the Imperial College of Science and Technology—and of his researches and publications upon the mineral resources of the British Empire and their relationship to national and international problems. "The Consolidated Gold Fields of South Africa, Ltd." premium of forty guineas to J. B. Richardson, for his paper on "The Importance of Recovered or 'Secondary' Tin." The "William Frecheville" Student's Prize of ten guineas to A. Bray, for his "Notes on the Banket Reefs of the Gold Coast Colony." The "Arthur S. Dwight" post-graduate traveling grant of two hundred guineas to W. D. Jones. In accordance with the conditions of the grant, Mr. Jones proceeded to the United States last October, where he spent about three months in the study of metallurgical plants and in making personal contacts with operating men. Since his return to England he has submitted to the council an exhaustive report of his visit. A special grant of £50 from the "Post-Graduate Grants Fund" of the institution to S. R. B. Cooke, to enable him to proceed to British Columbia to gain practical experience. The grant was made on the nomination of Professor James Park, dean of the faculty of mining and economic geology of the University of Otago, New Zealand.

A REPORT issued by the trustees of the British Museum describes the progress during 1929 both of the collection at Bloomsbury and of the Natural History branch of the British Museum at South Kensington. The director and principal librarian of the British Museum, Sir Frederic Kenyon, records a rise in the general attendance of visitors at the museum of over 10,000 compared with the previous year. The figures are 1,191,758 for 1929, and 1,181,617 for 1928. He attributes the greater part of this increase to the longer hours of opening on Sunday afternoons, which came into force in October, 1928. The month of August, 1929, with a total of 161,697 visitors, showed the highest monthly total on record, and in general the attendances in the second half of the year exceeded those in the earlier months. The number of visitors to the reading room fell off by rather more than 1,000 from the high total of 1928, the figure for 1929 being 214,375, an average of 707 daily. Visits of students to particular departments fell off from 276,890 to 272,352. Dr. C. Tate Regan, the director of the Natural History Museum, notes a general decrease in the number of visitors to South Kensington from 567,273 in 1928 to 541,198 in 1929. The Sunday afternoon attendances have decreased by less than 500, and the lectures of the official guide were attended by 12,972 persons, as against 13,826 for the previous year. The museum building is being extended and the new Spirit Building, designed at present for the use of the department of entomology, almost completed.

DISCUSSION

THE RELATION BETWEEN A NEGLECTED CLASS OF FACTS AND THE UNIVERSAL LAW OF ORGANIC EVOLUTION

THE importance to science of the dates of specific names is recognized. No stable nomenclature is attainable, even in a remote future, if they be disregarded. But to dates of first collection of species no such obvious weight attaches. Great as is the improvement in this respect, it is not yet by any means the universal practice to include even the date of collection of the type in the description of new forms. A generation or two ago such dates were commonly omitted, and to determine the dates of collection of specimens older than the type then or now is a matter of no little difficulty.

Yet dates of first collection are basic biological facts. They depend very definitely upon the location and extent of specific ranges. And, biologically speaking, where species are is second only in importance to what they are. In fact, they are where they are, because they are what they are.

These dates of first collection permit comparisons of various kinds to be made with respect to the time-order of discovery of known species; and from such comparisons interesting results, of which the following are an earnest, may be anticipated.

Investigation shows that in the Chiroptera, for example, the species of smaller genera make up a smaller proportion of the first than of the second half of the known total to be discovered. Or putting this generalization in other words, species of the larger genera are discovered more often early than late; of the smaller genera, more often late than early.

It is a perfectly natural conclusion that this inverse relation depends upon peculiarities in the distribution of species of the two sorts of genera, but this is at present somewhat beside the point. The main fact is that the species of to-day's small genera make up a larger proportion of the total known species of bats than they did in the early collections. By extension of the reasoning it is to be inferred that of the actual small genera in the world—those that will be the small genera at last when the census of species is complete—will form as that time approaches a larger and larger proportion of the known total.

Under these circumstances it is clear that the curve of genera plotted by size will change as time passes, and change in a predictable way.

This raises an old problem in new form.

Biologists must ask themselves now, not why the curves of genera plotted to species should be essentially uniform for the different natural groups of plants and animals, as Dr. J. C. Willis discovered them to be. Instead, they must ask why these curves, now alike, are changing in the same direction, and apparently approaching the same limit.

Dr. Willis's discovery means that there is one law of evolution manifest upon the same terms in all natural groups of organisms. For if in different groups the proportionate number of genera of different sizes is constant, genera are multiplied and with the passage of time increase in size according to one system, and one only.

What this system may be is, of course, not to be discovered through analysis of empirical curves of genera plotted to species, but through study of the limiting form toward which they are moving.

Under the circumstances it quickens the imagination to discover that this limiting curve is at least very close to, if not identical with, a definite mathematical function of the curve of normal frequency. As a matter of fact, there is independent and apparently conclusive reason for believing that precisely this function of the normal curve is the ideal to which the curve of genera plotted to species should conform.

The equation of the ideal may be written in terms of the constants and variables of the normal curve. This equation gives the law of evolution as concise and accurate expression as is possible. It was stated, not altogether correctly, in more familiar terms in an earlier issue of SCIENCE.[1] In corrected form it appears in the *Anatomical Record*.[2]

W. H. LONGLEY

GOUCHER COLLEGE

THERE IS NO CONTROL

A WORD is needed to mean definitely the things we can do to avoid injury from pests affecting crops. The writer was one of those who early adopted the word control with the hope that this word when applied to insect pests would come to mean precisely that. Every one will admit that this is the chief meaning at present, but *there is no control of language* because there are just enough people who insist on stretching it to cover other meanings to leave it uncertain.

Let us suppose the case of a farmer writing to me concerning a certain pest and asking how it is con-

[1] W. H. Longley, "A Note upon the Probable Mode of Evolution," SCIENCE, 69: 462–465, May 3, 1929.

[2] 44: 241, 1929.

trolled. I might answer, "My dear fellow, the pest is already controlled by lethal factors and fluctuations of food supply, the cold, heat, winds and storms control it as do natural barriers, such as rivers, etc., and besides certain birds and beetles control it. Likewise, a fly parasite and a parasite wasp. Unfortunately, the latter is also controlled by a hyperparasite." In reply, supposing his anger was controlled by various inhibitions, including an inferiority complex, he might say, "Excuse me that I did not use the right word, but I am an unlearned and ignorant man. The insect has now controlled the crop and it is all dead."

I want to protest again and as strongly as I know how against the above uses of the word for meanings for which there are so many more precise designations and to urge that these other words be used, such as natural checks, climatic restrictions, topographical barriers, biological limitations or even environmental resistance for all these things that have no direct practical bearing on the problems of the farmer. He is thinking of the things that he can do to avoid the losses due to insects, fungi and other troubles. Control in this usual sense applies correctly in such cases as frost control which is accomplished by orchard heating and to moisture control by means of irrigation and cultivation. It would be just as bad to confuse these practices with meteorological limitations, restrictions or barriers. Our cooperative associations are beginning to accomplish very effectively the control of marketing to avoid this class of losses. In this work one also meets with commercial limitations, checks and barriers that must be considered, but must not be confused with what we can do to obtain better prices.

Those who insist on using the word control to express also other ideas should at least suggest another word that could be exclusively used to mean precisely what the great majority do mean when they say control.

C. W. Woodworth

Berkeley, California

BLACK WALNUT CANKER

In the fall of 1929, the extension specialist in forestry at West Virginia University, Mr. T. W. Skuce, informed me of the occurrence in the north central part of this state of a serious canker on the black walnut, *Juglans nigra* L. It was not until February, 1930, that I was able to obtain specimens in the field.

This disease has been observed upon trees varying in diameter from three to twenty inches. The cankers are located at any point on the older wood but are most conspicuous upon the trunk and larger branches where they form "cat-faces" or targets composed of very prominent concentric rings of callus tissue. The margins of the cankers are very rough, being composed of the last formed and largest roll of callus tissue, together with the attached bark. This gives the characteristic cankers a concentric flaring appearance with a diameter which is usually greater than the diameter of the trunk or limb at the point of canker formation. What appear to be young infections often show a burl-like growth before they open up to form the concentric rings so typical of the older cankers.

It has been noted also that whenever a tree is attacked several cankers are present and are well distributed on the trunk and larger limbs. Other trees near by may show no symptoms of disease. This is suggestive of an inherent difference in susceptibility among trees of similar ages in the same stand.

On many of the cankers, most commonly on the callus rings of two or three years ago, the perithecia of a Nectria are abundantly formed.

The appearance of this Nectria associated with such characteristic cankers suggests that this disease is closely related to the European canker which is well known in Europe on beech and other deciduous trees, and in America on the cultivated apple, but not reported as occurring upon black walnut. In fact, there are no published records so far as I can ascertain of this disease of the black walnut.

Because of the commercial importance of the black walnut in West Virginia and the fact that this disease renders the timber practically worthless, arrangements have been made by the Agricultural Experiment Station of West Virginia to conduct an investigation of this disease, including its geographical distribution, its origin, nature, host range, importance and the conditions surrounding infection and spread by the pathogen. This note is published to call attention to the black walnut canker; any information regarding its occurrence anywhere will be gratefully received.

C. R. Orton

West Virginia University

DUTCH ELM DISEASE IN OHIO

Several cases of the Dutch elm disease have been found in Ohio. The field symptoms exhibited were similar to those of the Dutch elm disease. The leaves wilted on certain branches or over the entire tree. Later, they turned yellow and dropped. The affected limbs died. When cross sections were made the typical brown discoloration of the vascular tissue was found, appearing generally as a broken ring but sometimes forming a complete circle. When the bark

was peeled back the stains appeared as short brown streaks in the spring wood.

The fungus which grew from the plantings of small pieces of the discolored wood on acidified potato dextrose agar produced a grayish white rather sparse and appressed mycelium showing zonation. Some of the colonies were yeast-like in appearance. Conidia approximately 1.5 x 3.5 μ were produced in heads on branched conidiophores. Budding of many conidia was observed. Coremia with spores approximately 3.3 x 1.7 μ formed on the wood plantings and on the agar.

A part of the lot of the original specimens sent to the Ohio Agricultural Experiment Station were forwarded to Dr. Christine Buisman, of Holland, at present at the Arnold Arboretum. She also isolated *Graphium ulmi* Schwarz from the diseased twigs.

The cases observed in Ohio have shown marked evidence of parasitism. The disease has been very destructive in Europe, and we should know as quickly as possible how wide-spread the disease is here. Specimens sent to the writer will be appreciated and will receive prompt attention.

CURTIS MAY

OHIO AGRICULTURAL EXPERIMENT STATION, WOOSTER

THE PHOTOTROPY OF ULTRA-VIOLET-TRANSMITTING GLASSES

Two years ago when the Boyce Thompson Institute entertained the local sections of the American Chemical Society, I noticed that a sheet of ultra-violet-transmitting glass, said to be Corex, which had been used in a hot bed frame and exposed to a quartz mercury lamp, showed a distinct pinkish brown tinge. A more striking observation was that a piece of the same glass, exposed also to a mercury lamp and in addition to sunlight, showed no coloration whatever and had remained perfectly colorless.

This observation suggested that Corex was phototropic, and that the longer wave-length light supplied by the sun tended to reverse the colorizing action of the mercury lamp.

This supposition has been confirmed by more recent observations. Wood and Leathwood[1] determined quantitatively that ultra-violet-transmitting glasses which had been colored by exposure to a mercury lamp were completely restored to their original transparency by exposure to sunlight. Shrum, Patten and Smith[2] and Nitchie and Schmutz[3] have shown that the color produced by mercury lamp solarization can be completely destroyed by heating the colored glass. Clearly, then, the colorizing action of short wave-length light is reversed by longer wave-length light, and by heat. That is, the phenomenon is one of phototropy.

The purpose of this note is to draw attention to the striking similarity between the behavior of ultra-violet-transmitting glasses and the more extensively studied though little known phenomenon of phototropy. It is thought that the history of lithopone and other phototropic substances[4] may be useful to those who have occasion to handle these new glasses and who may wish to control the solarization effects either in manufacture or in use.

LYMAN CHALKLEY, JR.

NEW YORK

[1] Wood and Leathwood, *Nature*, 124: 441, 1929.
[2] Shrum, Patten and Smith, *Transactions Roy. Soc. Canada* (3), 22: 433, 1928.
[3] Nitchie and Schmutz, SCIENCE, 71: 590, 1930.

THE RATE OF WORK DONE BY A RICKSHA-COOLIE

PROFESSOR BASLER'S article in the May 3, 1929, issue of SCIENCE on "Rate of Work Done by a Ricksha-Coolie," in which he finds one tenth horse-power as his work expended for short periods of time, is interesting. For comparison with his result, I present the following computation of the rate of work done by a man in walking (climbing) in the White Mountains, in going from the Ravine House in Randolph, New Hampshire, to the summit of Mt. Washington, by way of the Randolph path and the Gulf Side trail, a distance of nine and one half horizontal miles. The altitude of the Ravine House is 1,280 feet and of the summit of Mt. Washington 6,290 feet, thus giving a gain of 5,010 feet in making the ascent. To this should be added 270 feet as an allowance for two notable dips in the trail. This gives a total gain in elevation of 5,280 feet.

The trip can be made under favorable weather conditions in four hours. This would correspond to an average gain in elevation of 22 feet per minute. In the case of a man whose weight is 150 pounds, the power developed in merely raising his weight would be 3,300 foot pounds per minute, or exactly one tenth of a horse-power.

As in the case of the coolie, the man has also to expend energy in traveling the horizontal distance, and, of course, in overcoming numerous slight obstacles on the uneven path of the mountains. A sustained average of one tenth horse-power for a period of four hours would appear to be a creditable performance as measured by the figures reported by Professor Basler.

ALVAN L. DAVIS

[4] For a bibliography see *Chemical Reviews*, 6: 217, 1929.

SPECIAL CORRESPONDENCE

FIELD WORK OF THE NATIONAL MUSEUM OF CANADA, 1930

THE National Museum of Canada, in continuance of a fixed policy of conducting investigations among the aboriginal inhabitants of the country and of making zoological and botanical surveys, will have ten parties in the field during the summer of 1930. The National Museum profits also from the field work of the Geological Survey. Between the two institutions there is the closest cooperation, and the mineralogical and geological sections of the museum are assembled and maintained by the Geological Survey.

In the realm of anthropology efforts are being made to conduct vigorous research among the Indians with a view to obtaining information from the older people regarding the customs and culture of the race uninfluenced as far as possible by contact with the whites. The longer this work is delayed the less satisfactory are the results, as Indians have shown a great readiness to adopt from European civilization anything that will serve their needs. C. M. Barbeau, who has made extensive observations on colonial influences on the Indians of eastern Canada, will continue this summer his work in certain parts of Quebec, Ontario and New York, studying modern handicrafts and designs used by the Indians and concentrating on bag-making, basket-making, wood-carving and quill and moose-hair work with a view to getting a better comprehension of the original native art and culture.

An ethnological study of the Indians living around Lake Abitibi will be undertaken by J. T. MacPherson. This will include an investigation into the economic life of the Indians in earlier times, their original material culture, their social organization and the presence or absence of totemic clans, shamanism and its connection with the puberty fast, and their religious beliefs.

The summer will be spent by I. A. Lopatin among the Indians living around Kitimat, British Columbia, and an investigation will be made of their social and religious life, special attention being given to the phratric, clan and family systems with their crests and privileges, to their government, the institution of property and the potlatch system, social customs, religious beliefs and practices including secret societies and their rites and intercourse with neighboring peoples.

Dr. J. C. B. Grant, of the University of Manitoba, will make among the Cree Indians of Wabasca and of the reserves south of Lesser Slave Lake, Alberta, a complete series of physical measurements of adults and children. This is in continuation of the anthropometric investigations that Dr. Grant has been conducting among the Indians of the western interior of Canada.

Archeological excavations will be made near Newcastle, New Brunswick, and on the Magdalen Islands, Quebec, by W. J. Wintemberg. It is hoped that some light will be thrown thereby on differences in handicraft between the Micmac Indians of eastern New Brunswick and those of the Nova Scotia coast. Excavations on the Magdalen Islands may reveal a southward extension of Eskimo cultural influence, evidences of which have been detected on the west coast of Newfoundland.

The biological division of the museum will have five parties in the field. Jacques Rousseau will carry on a botanical survey of parts of Nova Scotia and collect flowering plants for the herbarium. This is in connection with the preparation by Dr. M. O. Malte of a comprehensive work on the systematic flora of the Maritime provinces. Dr. H. M. Raup will complete a botanical survey which he has been conducting since 1928 of a part of Wood Buffalo Park west of Slave River.

A study of the mammals of southeastern British Columbia will be continued by H. M. Laing; collections will be made and observations recorded with regard to their distribution and the relation of distribution to variations in topographical features. Collections will also be made in Jasper Park and Rocky Mountain Park. P. A. Taverner will commence this season a thorough ornithological investigation in the vicinity of Churchill on the west coast of Hudson Bay, making observations on the migration of birds and their habitat and making extensive collections for detailed study. Jos. Rochon will spend a part of the season in collecting mammals in the vicinity of Ottawa.

The National Museum is an outgrowth of the Geological Survey and is dependent on it for exhibition material in geology, paleontology and mineralogy. Fine specimens of ores and rocks from leading mining districts are obtained by economic geologists, and invertebrate fossils by stratigraphic paleontologists. It is expected that a good collection of vertebrate fossil material will be obtained this season by C. M. Sternberg from the Peace River block. A. T. McKinnon will collect mineral and rock specimens from different parts of Ontario and Quebec. The greater part of this material will be used in preparing sets for prospectors and for educational institutions, but the choicest specimens will be added to the permanent collection of the museum.

W. H. COLLINS

QUOTATIONS

THE WINNIPEG PROGRAM OF THE BRITISH MEDICAL ASSOCIATION

ON August 22 the Canadian Medical Association begins the business of its sixty-first annual session at Winnipeg, under the presidency of Professor W. Harvey Smith, and three days later members of the British Medical Association from this country and other parts of the Empire assemble in that city, as guests of our Manitoba colleagues, for the ninety-eighth annual meeting of the British Medical Association. On August 26 they will be welcomed by the Prime Minister of Canada and the Mayor of Winnipeg, and Professor Harvey Smith, after installation as our president for 1930–31 at the hands of Professor Burgess, will deliver his inaugural address. The association has only met twice before outside the British Isles, and each time in the Dominion of Canada—at Montreal in 1897 and at Toronto in 1906. On this occasion something more than friendship and common ties will unite visitors and hosts, because since the year 1924 the two professional bodies, by accepting formal affiliation, have come into close organic touch on matters of mutual concern. The Winnipeg meeting of 1930 is thus a landmark in association history. Those who are fortunate enough to take part in it will have done something to strengthen the links between the profession at home and the profession overseas, and to show that the British Medical Association is Empire-wide in its outlook.

The revised program of work for the scientific sections, with a good deal of other information about the arrangements for the meeting, appears in our Supplement this week. Brief particulars of the journey by sea and land, and some useful hints for travellers, are also given, but any member proposing to go to Winnipeg should apply at once to the financial secretary for a copy of the booklet containing full details of the various tours. In general the program for the annual meeting of 1930 follows fairly closely the pattern with which we are familiar on this side of the Atlantic, except that all medico-political business will already have been disposed of at the annual representative meeting which opens on July 19 at the association's headquarters in London. The fourteen sections are to meet on the mornings of August 27, 28 and 29, and a very varied and interesting list of subjects, both clinical and scientific, has been drawn up for consideration. While the number of set debates is larger than usual and several sections will combine to discuss borderline topics, the occasional paper has not been elbowed out altogether, and (as an example of how hard it is to draw a clear-cut line) the subject chosen for the joint meeting of the sections of surgery and tuberculosis is so wide that its "discussion" might almost as well be described as a series of independent papers, each concerned with a different aspect of thoracic surgery.

Some of the social events of the week—they include a skating carnival and an Indian pageant—have a very agreeable air of novelty to English eyes. A break with tradition will be perceived also in the announcement of five clinical addresses to be delivered at special afternoon sessions. When our brethren in Canada travel long distances to take part in a medical congress they mean business, and the chance of hearing an authority from these Islands speak to them on his own subject is in their opinion too good to be missed. They expect some fun, but work comes first. Hence Sir William Wheeler, Dr. H. C. Cameron, Sir Lenthal Cheatle, Professor W. E. Dixon and Sir Farquhar Buzzard (whose subject, perhaps chosen in a spirit of gentle irony, is "Rest, Work and Play") may be sure of large and appreciative audiences in the Winter Club on summer afternoons. For like reasons, we may suppose, Lord Dawson and Dr. Robert Hutchison have been persuaded by the local executive to address a public meeting on the night of August 27; and the week's proceedings will fittingly close with the delivery of Lord Moynihan's Listerian Oration, under the chairmanship of Professor John Stewart of Halifax, a veteran surgeon who was Lister's pupil and friend in Edinburgh and is one of the most admired and respected personalities in the Canadian medical profession.

A very warm welcome awaits every member who visits Canada next month. Those on this side who have been in constant touch with them during the past two years and more know that the president-elect and his immediate local colleagues, Dr. J. D. Adamson, Dr. C. A. Mackenzie and Dr. Ross Mitchell, are determined to make the Winnipeg meeting memorable in the annals of the British Medical Association; and that the Canadian Medical Association, through its general secretary, Dr. T. C. Routley, and its acting-editor, Dr. A. G. Nicholls, is cooperating in the fullest measure. If hard work, enthusiasm and foresight can ensure success, then the ambition of Professor Harvey Smith and company will be realized. Canada is very good at organizing affairs, large or small. Almost the only thing they can not guarantee without our help is an attendance from the British Isles worthy of the occasion and of their efforts.—*British Medical Journal.*

SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE IOWA PIANO CAMERA

THE apparatus here described was developed for the purpose of studying piano playing. It gives an objective photographic record of the duration, time of incidence and time of ending as well as a relative measure of intensity of each note struck for a piano selection under normal conditions of performance.

The record is made on a 4-inch Eastman sensitized paper, passing at the rate of 12.5 centimeters per second. The record consists of a path for each of the keys on the piano keyboard and shows for each key the exact moment at which the hammer strikes the string and the moment of the beginning of the release of the key. It also shows for each note the velocity of the hammer in terms of the time for traversing the last 12 millimeters in the stroke of the hammer. On the same principle, a separate line on the film indicates the movements of the damper pedal. The time is indicated by 25 parallel lines to the second across the width of the entire film.

The record is made of the movement of the hammer by having a very light paper strip, approximately 7 centimeters long and 7 millimeters wide, glued to the tail of each piano hammer. This strip has a narrow slit, 3 millimeters by 7 millimeters, at a distance of 12 millimeters from the end of the strip. The camera is set 4 feet above the piano, directly above the hammers, and an anastigmatic 1:6.1 lens is used. The height of the camera with this lens is so adjusted that the 4-inch film will cover the entire bank of hammers. Beneath the hammers is placed a bank of 18 60-watt Mazda lamps. A layer of glazed glass over the lamps diffuses the light and forms a support for the paper strips. A slit 2 millimeters wide and equal in length to the width of the film is placed in the camera between the film and the lens. This slit permits only a small portion of each paper tail—a section between the slit and the hammer—to be focused on the film. When the key is struck, the hammer moves toward the piano string and the slit in the paper tail allows the light to pass through to the camera. The passing of this slit leaves a dot photographed on the film.

When the hammer reaches the piano string and produces the sound, the entire tail has passed the region focused on the film and the light again falls upon the film, making a distinctive mark on the film. As soon as the hammer has struck the string, it immediately drops back to the position where the slit in the paper tail is within the region focused on the film. The hammer remains in this position, photographing as a narrow band on the film until the key is released. The movements of the damper pedal are recorded on a similar principle. The duration of each tone, whether due to holding down the key or holding down the damper pedal, is indicated with precision on the film.

The velocity of the stroke as indicated by the time of the hammer in passing 12 millimeters is taken as a qualitative and relative measure of stress or intensity of tone and is read in terms of millimeters.

The time line employed is somewhat of an innovation and will be described because of its possibilities for use in other types of apparatus. A neon lamp, built in the shape of an inverted U, is placed in the camera with the base of the U extending across the width of the film and separated from it by a strip of thin sheet brass containing a very narrow slit (about .5 millimeters wide) and as long as the width of the film. The neon lamp contains a small amount of mercury, giving a pale blue light to which the film is exceedingly sensitive. The lamp is operated by placing it in series with the secondary of a small induction coil. In series with the primary of the coil are placed one dry cell and a 25 dv. electrically driven tuning-fork. The latter makes and breaks the current in the primary of the coil 25 times per second, the neon lamp flashing only on the break. This arrangement gives 25 parallel lines to the second, each extending across the width of the film. At present, we are running the film at approximately 12.5 centimeters per second, which separates the parallel time lines by 5 millimeters. At this speed, measurements to .02 of a second can be made with accuracy, and measurements to .01 of a second with only a very slight error. Finer measurements can easily be made, if desired, by using a tuning-fork of higher frequency.

The value of parallel time lines, each of which entirely crosses the film, was realized some time ago by Dodge.[1] Time lines of this kind are especially convenient in this apparatus when it is desired to measure such factors as the beginning, ending and duration of the notes within a single chord.

In addition to its use as a means of analyzing artistic piano performance, the apparatus may also be used to secure an objective measure of motor rhythm under an actual situation where this ability must be used. In short, it records quantitatively, with adequate precision, the temporal aspects of tone production on the piano and furnishes a serviceable indication of relative stress, so that all the elements of rhythm in any degree of complex musical movement may be analyzed for interpretation. The other two factors, pitch and timbre, are controlled by the

[1] Raymond Dodge, "A Pendulum-Photochronograph," *J. Exp. Psych.*, 9: 155–161, 1926.

piano itself. The film, therefore, furnishes a full and adequate record of piano performance.

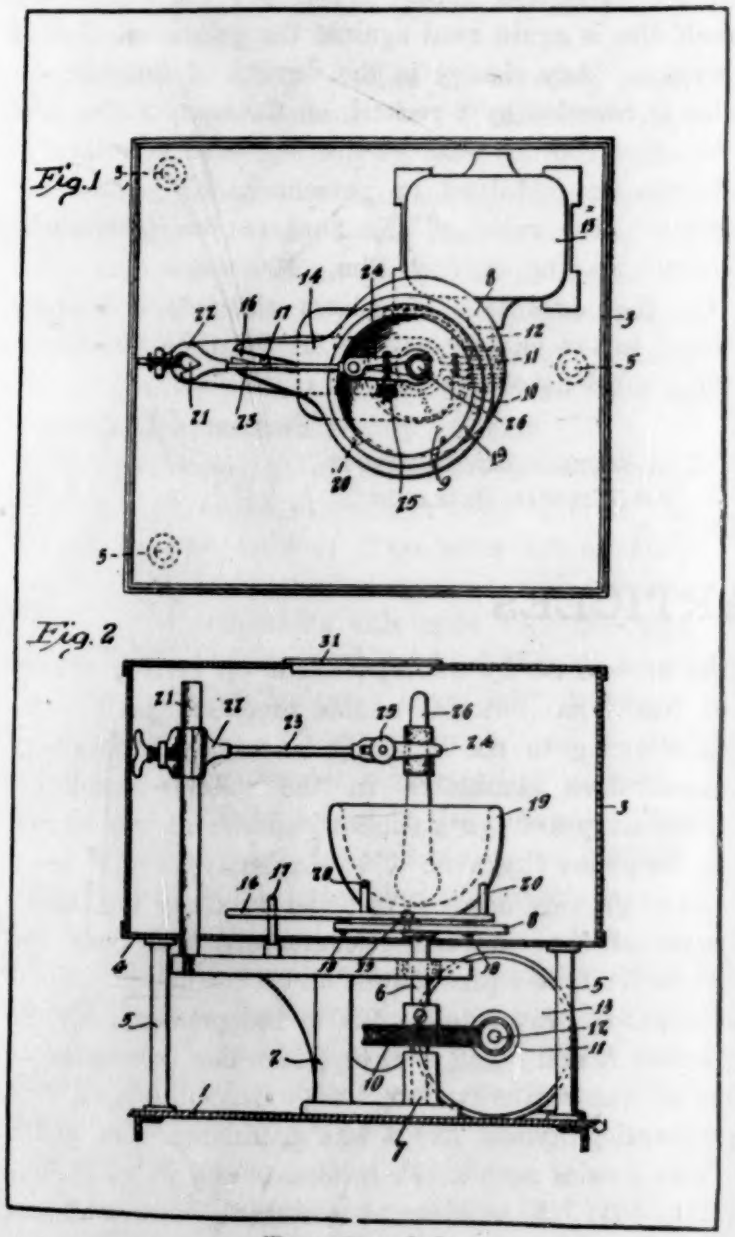
This preliminary notice of the camera was sent to this journal because it was felt that the method here employed has many possibilities for application in other fields of science.

JOSEPH TIFFIN
CARL E. SEASHORE

STATE UNIVERSITY OF IOWA

A NEW MECHANICAL DISINTEGRATOR

INVESTIGATORS working with filterable viruses appreciate how much time may be consumed in reducing virus tissues to a finely divided physical state, a task generally carried out by hand with the aid of a mortar and pestle. This method of grinding tissues is not only comparatively inefficient but also exceedingly monotonous and tiring. In order to overcome these objections in our own work, we designed a machine some time ago whereby the mortar and pestle could be operated mechanically. This apparatus has proved so satisfactory that we offer a brief description of it for the benefit of those who may be interested.



FIGS. 1 and 2

Fig. 1 gives a top view and Fig. 2 a lateral view of the machine. It consists of a suitable cast-iron pedestal (2), provided with a thrust bearing (7), into which is fitted a shaft (6), which passes through the floor (4) of the grinding chamber and bears at its upper end a driving disk (8) provided with several eccentrically placed apertures (9). Shaft (6) is driven by means of worm gear (10), which engages with a worm (11), attached to the horizontal shaft (12) of an electric motor (13). The machine is fastened to a metal base (1) on which rest also the legs (5) which support the floor (4) of the grinding chamber.

Within the grinding chamber a platen (14) is movably positioned above disk (8) by means of a pin (15) which fits into one of the eccentric apertures (9). The platen (14) is provided with a bifurcated end (16), which engages with a fixed pin (17) attached to the pedestal (2). The mortar may be fixed into position on the platen by means of rubber-covered metal fingers (20) extending upward from the platen (14).

The pestle (26) is held in position by means of a round flexible metal arm (23) provided with a clamp (24), operated with a thumb screw (25). The metal arm (23) is fastened by means of a special clamp (22) to a vertical triangular rod (21) fixed to the pedestal (2).

The mechanism described imparts to the platen holding the mortar an eccentric motion. By thus moving the mortar the pestle is brought into essentially the same operable relationship with the mortar as when the grinding process is carried out by hand. When desirable, grinding may be carried on under a hood (3), which may be entered by means of a hinged lid, provided with a glass window (31) to facilitate inspection of the material while the machine is in operation.

The machine described should prove useful not only in grinding virus tissues, but also in grinding most substances that are commonly disintegrated by means of a mortar and pestle.

E. W. SCHULTZ
F. D. BANHAM

STANFORD UNIVERSITY

A METHOD OF TITRATING PROTEOLYTIC ENZYMES

IN 1927[1] the author published a brief note on a method of enzyme titration, which was later somewhat modified and demonstrated at the 1928 meeting

[1] *Proc. Soc. Exp. Biol. and Med.*, 24: 936, 1927.

of the Federation of American Societies for Experimental Biology. Since it has not yet been found possible to elaborate the technique, with protocols, in a longer article, as had been hoped, it seems best to publish these suggestions now and so to make them generally available for adaptation to individual problems in enzyme research.

The method is based on a reduction in the density of pieces of exposed photographic film by the release of silver through the progressive proteolysis of the gelatin layer. The relative densities before and after exposure to the enzyme solution are read against a suspension of the same gelatin-silver emulsion in a Duboscque type colorimeter, or by means of a photometer.

The film: Eastman Commercial, 8″ x 10″; 2 to 6 in a pile, irradiated by Roentgen ray, 50,000 v., 10 m.a., 25″ target distance, 2 min. exposure. (Small rectangles may be defined and numbered by lead strips and figures cemented to the cassette.) The exposed film is fully developed, fixed in plain hypo (no hardener), washed, dried, rewashed, dried again and cut into rectangles 2 x 2.5 cm.

The cells: No. 14 (1.5 mm) copper wire coiled around a 1.3 cm rod is snipped off in nearly complete circles (0.5 cm opening), bent flat and sealed with paraffin on 1.5 x 2 cm glass slips, with the opening on a 2 cm side. Backs are glass slips 1.5 x 2 cm. Cell, film and back are clipped together with a spring clothes-pin.

The colorimeter: A Klett, Bausch and Lomb or other Duboscque type is used, with spring clips under the tube shelves to hold the film carriers. These carriers are double leaves of thin brass, lacquered flat black, with centered 1 cm holes, between which the film is slipped for insertion under the shelf in the light path. The suspension for comparison is made of gelatin-silver emulsion, dissolved off of two films in hot water. Glycerin is added to 50 per cent. to delay sedimentation. A completely cleared film is used in the carrier under this tube. Fifty per cent. glycerin solution fills the tube above the test films. Both tubes must be at the same level when readings are made.

Method of use: Readings are made on each film before use, one film being reserved as a control. The others are each placed between a glass back and the copper ring of a cell, gelatin side to copper ring, and the whole held together with a spring clothes-pin. Enzyme solution is filled into the cell with a capillary pipette, and the cell placed upside down, gelatin film surface forming the roof, at constant temperature for a carefully timed interval. (A separate film is used for each determination desired.) Then the clothes-pin is released, the film is rinsed quickly in cold water and dried rapidly, clipped by one corner, before a fan. Units should be started at not less than fifteen-second intervals to allow for this rinsing of the successive films. When dry the density of each film is again read against the gelatin-silver suspension. Any change in the density of this suspension is revealed by a recheck on the control film, and the other control readings are corrected accordingly. Results are obtained in percentage of gelatin unaffected—the ratio of the final to the (corrected) control reading on each film. 100 minus this ratio, (*i.e.*, the percentage of gelatin affected) is proportional to the enzyme activity at the time and under the conditions of the test.

FREDERICK L. GATES

THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH

SPECIAL ARTICLES

THE PRODUCTION OF HOMOZYGOTES THROUGH INDUCED PARTHENOGENESIS

BOTANISTS attempting to produce species hybrids have frequently obtained plants which resemble the maternal species exclusively. I have myself noted such results in various efforts to cross species of Nicotiana and of Fragaria. Obviously the most likely explanations of these phenomena (apart from certain special cases to which it is unnecessary to refer in this note) are (a) induced development of vegetative tissue, such as that of the nucellus, and (b) induced parthenogenesis.

More than a decade ago I endeavored to determine the true cause by an experiment on certain species of Nicotiana; but was unable to obtain positive results owing to the difficulty in finding satisfactory quantitative characters in the species employed. Some six years ago a similar experiment was started on the genus Fragaria. Two similar types of *F. vesca* ($2n = 14$) were crossed, in order to study the inheritance of the contrasting characters, red fruit and white fruit, and pink flower and white flower. These characters proved to be due to independent pairs of factors *R* and *r* and *P* and *p*, in which dominance of color was virtually complete. Accordingly, a first generation hybrid RrPp was pollinated with pollen from species such as *F. chiloensis* and *F. virginiana* ($2n = 56$). A number of maternals were obtained

exhibiting the gametic types RP, Rp, rP, and rp, thus indicating induced parthenogenesis. If induced nucellus division had been indicated, the resulting plants must all necessarily have been red-fruited and pink-flowered.

Owing to the extreme lightness of the pollen of all the strawberry species, the earlier results were questioned, and the experiment was repeated under the most careful conditions. Of twenty-four plants which have now fruited, twelve are red-fruited and pink-flowered, three are white-fruited and pink-flowered, seven are red-fruited and white-flowered and two are white-fruited and white-flowered. These plants are all diploids ($2n = 14$).

Naturally the possibility is not excluded that a portion of these plants arose through the division of vegetative cells. On the other hand, at least a portion—and perhaps all—of the plants must have arisen through induced parthenogenesis. That is to say, the beginning of development must have been haploid. This being true, the ensuing diploidy is most likely to have come about through ordinary mitotic division. The plants are therefore complete homozygotes.

As yet I can not say whether the breeding results corroborate these conclusions. It will take three years more to grow selfed progeny of each maternal plant. But in looking back over data on Nicotiana species recorded before the war, I find that as high as 100 seeds per capsule yielded maternals in certain attempted crosses where the full complement of seed per capsule is about 400. Notes, photographs and measurements show that the populations resulting from these seeds were extremely uniform.

Since the production of maternals is common in many species when an attempt is made to cross distant species, since some of these cases are certainly instances of induced parthenogenesis with ensuing diploidy, I am publishing this note with the hope that geneticists working with each of the important agricultural and horticultural crops will undertake similar experiments. If the technique can be improved so that a reasonable percentage of parthenogenetic embryos can be forced to develop, and if the majority of these prove to be homozygous diploids, the importance of the procedure to agriculture can hardly be over-emphasized.

I can give very few suggestions regarding technique; but perhaps the following points may be helpful. The indications are that (a) pollen which will produce tubes that will enter the micropyle are likely to induce parthenogenesis whether or not hybrids are occasionally formed; (b) parthenogenesis is not induced when the two species are so similar that hybrids are usually formed; (c) diploidy is probably the result of mitotic division of the chromosomes without nuclear division, division then taking place normally. Possibly X-ray or radium treatment or other stimuli will produce similar results. The main point to be guarded in experiments is to use mother plants having a genetic constitution that will permit easy detection of parthenogenetic diploids.

If this means can be used for the production of complete homozygotes, the labor of producing homozygotes through long periods of self-fertilization will be eliminated. First generation hybrids of homozygous stocks of many perennials such as grapes, blackberries, strawberries, apples, plums, etc., can then be tested out. Moreover, it would be possible to use homozygotes of annuals produced in this way for plot-testing experiments, for physiological researches and for determining residual variability due to external conditions.

Professor R. A. Emerson writes to me stating that for several years he has been endeavoring to secure haploids parthenogenetically with the hope that some diploid seeds can be obtained by selfing them. Professor L. J. Stadler also has been working for and obtaining haploids by means of treatment with X-rays. In this connection it might be pointed out that possible non-disjunctions, translocations, inactivations of small portions of chromosomes, etc., in haploids might reduce the probability of obtaining complete homozygotes in this way; whereas mitotic division of each chromosome at the first nuclear division of the stimulated egg-cell (if that is what occurs) would practically insure homozygosis. Second, certain experiments can be set up which would insure the detection of parthenogenetic haploids which would not insure the detection of parthenogenetic diploids. Experiments should be planned to detect both types.

E. M. EAST

BUSSEY INSTITUTION

THE PRODUCTION OF BACTERIA-FREE AMOEBIC ABSCESSES IN THE LIVER OF CATS AND OBSERVATIONS ON THE AMOEBAE IN VARIOUS MEDIA WITH AND WITHOUT BACTERIA[1]

SINCE the cultivation of *Entamoeba histolytica* by Boeck and Drbohlav five years ago, a number of investigators have attempted to obtain this amoeba free of bacteria, but without success. Various dyes have been placed in the cultures with the hope of inhibiting bacterial growth without inhibiting the growth of the amoebae or without killing them. Also the cysts have

[1] Aided by a grant from the DeLamar Mobile Research Fund.

been washed and treated with chemicals before being placed in culture media. We have tried these methods, too, and mostly without success. However, when the cysts were washed in sterile (Berkefeld) filtered tap-water four or five times daily for ten days and stored at 2° to 4° C. while not being washed, it was possible on three occasions to obtain a few bacteriologically sterile amoebae after treating the washed cysts for three minutes with a 1–1000 solution of bichloride of mercury, and, after four washings, allowing the amoebae to excyst in fresh horse serum-saline 1–6. But the amoebae obtained were few in number, even though several million cysts were treated, for most of the cysts were killed by the treatment.

Practically every one who has attempted to free this amoeba of bacteria has felt that it would grow readily if separated from bacteria. But we have not found this to be true. None of the bacteria-free trophozoites which were obtained by the treatment given above lived longer than six days, and after the second day they were evidently abnormal organisms both in size and movement. But this may have been the result of the treatment employed.

So far as we know, no one has attempted to take advantage of the fact that the liver (of the cat) is capable of destroying many kinds of bacteria. We have found that it is sometimes possible for the liver of the cat to destroy the bacteria accompanying *E. histolytica* in culture and thus leave the amoebae in a bacteria-free amoebic abscess. This, of course, does not happen until the amoebae have been in culture for a month or more, probably on account of the fact that the bacteria are too virulent for the liver to destroy until they have been in culture for some time. Moreover, some pathogenic bacteria are probably overgrown and disappear from the cultures. All attempts to inoculate the amoebae directly into the liver from dysenteric stools have failed to produce bacteria-free abscesses; a majority of the animals inoculated in this way die within two to three days. It is possible, of course, that the inocula which we have used have been too large; had fewer bacteria and amoebae been inoculated, the bacteria, and not the amoebae, might have been killed. The inocula from dysenteric stools were from 0.2 to 0.3 c.c., and those from cultures were 0.5 c.c. each and contained about five million amoebae. Inoculation was made directly into the liver with a hypodermic needle following laparotomy. It was practically impossible to inoculate the amoebae into the liver without doing a laparotomy. The amoebae were cultivated on liver infusion agar slants covered with horse serum-saline (1–6) with a 5-mm loop of sterile rice flour added to each culture tube.

The best success we have had in producing bacteriologically sterile abscesses in the liver of cats was in a series of experiments in which thirty animals were inoculated. Of this number, abscesses developed in twelve, and the amoebae from eight of these abscesses were obtained in culture free of all bacteria. In many instances, however, the percentage of bacteria-free abscesses has been much smaller, sometimes not more than 5 per cent. being free of bacteria.

The following procedure was carried out in removing the abscesses from the liver and in testing them for bacteria. The cat was given ether and as soon as relaxation occurred was fastened to an operating board and the hair moistened with alcohol. When respiration stopped, the skin was removed from the ventral surface and the abdomen thoroughly seared with a large spatula. Then the liver was exposed by cutting through the abdominal wall with a red-hot platinum knife. That portion of the liver containing the abscess was severed with sterile instruments and the abscess placed in a Petri dish. Now, after searing the outer surface of the abscess and that portion of the liver which was removed with it, with a small platinum spatula, the abscess was cut into pieces from twice the size of a pea to one fourth this size, and these pieces were placed in tubes of sterile culture media, one piece in each tube. Many kinds of media were used and will be described presently. It was possible to inoculate from fifty to one hundred tubes from a single abscess, depending on the size of the abscess. The cultures were incubated aerobically and anaerobically for three to four days in determining whether bacteria were present or not. There is no doubt that some of the anaerobes which appeared in the cultures came from the liver of the cat instead of the culture (of amoebae and bacteria) which was inoculated into the liver, for it was possible sometimes to isolate similar organisms from uninoculated livers.

A fairly large series of experiments has been carried out in an effort to determine how soon after inoculation the bacteria are killed by the defense mechanism of the cat's liver. The earliest we have obtained the amoebae free of bacteria was seven days after inoculation. In our experience, from seven to nine days after inoculation is the best time to obtain the amoebae with no bacteria. We can not state definitely yet just what happens to the abscesses which contain no bacteria if the animal is not killed for examination, because we have not carried out a sufficient number of experiments. But the experiments which we have carried out indicate that soon after the abscess becomes free of bacteria it begins to heal and that within a few days, perhaps five to ten, no amoebae are present. This statement is based on

five observations: two where the abscesses were free of both amoebae and bacteria, and three where definite evidence of spontaneous healing was present.

As a result of the inoculation of the amoebae and bacteria into the liver, we have failed to produce abscesses in some instances while in other instances we have produced abscesses which ranged all the way from purely bacterial ones with no amoebae in them to those which contained only amoebae. In those in which only bacteria were present, the amoebae had probably been killed off or crowded out by the growth and activity of the bacteria, while in those where the activities of the bacteria were partly checked by the cat, it was possible for both amoebae and bacteria to live together as they do in the lumen of the intestine or in culture media. Whenever amoebae were present in an abscess, regardless of whether bacteria were present or not, there was no membrane or wall of granulation tissue at the edge or periphery of the abscess. This fact made it possible to tell at a glance whether amoebae were present or not. Whenever pus was present in the abscess, the amoebae were always found to be accompanied by bacteria. When a large amount of pus was present in the center of the abscess, as was sometimes the case when many bacteria were present, the amoebae were confined mostly to the outer portion near the uninjured tissue. But when no bacteria were present, the entire abscess was hard and dry and the distribution of amoebae was uniform throughout the abscess. In the abscesses which we have studied, there has been no indication that the amoebae ever bring about pus formation. However, if the abscesses were to run a long time—perhaps months or years as they are supposed to do in man—it is possible that pus might be formed.

We have estimated that each of the pieces of the bacteria-free amoebic abscesses which were placed in culture tubes contained from five to ten thousand large active trophozoites. These bacteriologically sterile amoebae have been placed in many kinds of culture media employed in the cultivation of bacteria, all the media that have been used in the cultivation of amoebae, and many others, but in no instance have they lived longer than fourteen days. There was some multiplication in several kinds of media, but the amoebae never multiplied so rapidly as they do when certain bacteria are present. The two kinds of media which gave the greatest promise of successful cultivation were: (1) egg slants covered with horse serum-saline (1–6) with one to three drops of laked blood added to each tube; and (2) liver infusion agar slants covered with horse serum-saline (1–6) with 1 c.c. of hydrolyzed haemoglobin and three drops of the sediment from autoclaved red cells of the horse added to each tube. Many substances were added to each medium; for instance, red cells of the cat, sterile cells from the liver, brain, spleen and kidney of the cat, rice flour, pure rice starch, various kinds of heat-killed bacteria, egg-white, egg yolk, glycogen, glucose, powdered milk, coagulated albumen, etc., but the amoebae were never successfully cultivated. In a few instances the growth of the amoebae appeared to be stimulated somewhat when the oxygen tension was reduced.

We have not spent a great deal of time in cultivating the amoebae with pure cultures of bacteria. In most of the experiments, a medium composed of liver infusion agar slants covered with serum-saline (1–6) and sterile rice flour has been used. After the amoebae had been definitely proved to be free of all bacteria, they were transferred to this medium and then the various bacteria were added. With some bacteria there was little or no multiplication of the amoebae. To this group belong certain of the spore-formers—*Bacillus megatherium, B. cereus* and *B. subtilis*—and *Proteus vulgaris, Escherichia acidi-lactici, Pseudomonas aeruginosa* and *Alcaligines fecalis.* With the spore-formers *B. niger, B. mesentericus* and *B. brevis,* the amoebae grew rather poorly for the first two or three subcultures, but after this they grew better and finally became abundant. They have been grown with *B. brevis* for almost a year and are no doubt capable of growing indefinitely. With *Escherichia communior, Vibrio comma* and *Neisseria catarrhalis* they grow well from the start.

L. R. CLEVELAND
ELIZABETH P. SANDERS
DEPARTMENT OF TROPICAL MEDICINE,
HARVARD UNIVERSITY MEDICAL SCHOOL

THE SPECIFIC ACTION OF A BACTERIAL ENZYME ON PNEUMOCOCCI OF TYPE III

A SYSTEMATIC search for enzymes capable of hydrolyzing the polysaccharides found in the capsular material of pneumococci of the various types has been carried on in this laboratory for several years. A number of enzymes from animal and plant sources, known to be active in the hydrolysis of simpler carbohydrates, were tested, but none of them were found capable of attacking the polysaccharides of pneumococcus origin. In addition, cultures of various moulds, yeasts, soil actinomycetes and bacteria, many of which were known to decompose cellulose, were tested without success. Recently, however, a bacillus has been isolated from the organic matter of soil taken from the cranberry bogs of New Jersey, which is able to split the specific capsular polysaccharide of pneumococci of Type III. The micro-organism is

a pleomorphic, Gram negative bacillus, motile and spore-bearing. A detailed description of the special technique employed in its isolation and cultivation, together with a more complete account of its biological characters, will be given in a subsequent publication.

From cultures of this bacillus it has been possible to extract a soluble principle which, in the absence of the living cell, decomposes this specific carbohydrate. The decomposition of the specific polysaccharide is indicated by the appearance of reducing sugars in the hydrolyzed mixtures and by the simultaneous disappearance of serological specificity. The rate of reaction and the total amount of specific substrate decomposed appear to bear a quantitative relationship to the concentration of the active principle.

The active substance present in the sterile bacterial extracts is heat labile, being destroyed by exposure to a temperature of 60° to 65° C. It is extraordinarily specific in its action against the polysaccharide of pneumococci of Type III, since the capsular carbohydrates of the specific types of Friedländer's bacillus, and even those of pneumococci of Types I and II, are unaffected. The fact that the reacting substance is a product of living cells, that it is specific and heat labile and that its action seems to conform to the laws of enzymatic reactions strongly supports the view that the active principle is of the nature of a specific enzyme.

The addition of an active extract to media does not inhibit growth or cause lysis of pneumococci; however, organisms of Type III, when grown under these conditions, are not specifically agglutinable in immune serum of the homologous type. That the *function* of elaborating the type-specific substance is not destroyed, however, is shown by the fact that pneumococci so treated continue to produce the capsular polysaccharide when transferred to a medium devoid of the active hydrolyzing agent. These two facts, namely, the decomposition of the specific carbohydrate removed from the pneumococcus cells and the hydrolysis of the specific capsular substance as rapidly as it is formed in growing cultures are evidence that the active principle is directed against this single, specific component rather than against the cell as a whole.

Previous studies on infection with pneumococci have led to the view that the invasiveness of these organisms is conditioned, in part at least, by the presence of the cell capsule. Since, early in the present work, the experimental evidence pointed to the fact that only the capsular material of the cell is vulnerable to the attack of this enzyme, it was tempting to determine whether the course of pneumococcus infection in a susceptible animal might not be favorably influenced by the injection into the animal of this specific enzyme. This possibility seemed more likely, since it was found that the activity of the enzyme *in vitro* is not inhibited or retarded by the presence of fresh animal serum. Repeated experiments with various preparations of sterile extracts containing the specific enzyme have demonstrated that the active principle has a distinct and specific protective action in mice experimentally infected with pneumococci of Type III. The protection afforded is type-specific, being effective only against pneumococci of this particular type. The protective value of the enzyme is destroyed by heating the bacterial extracts at 70° C. for 10 minutes. The capacity of any given preparation to protect animals against infection bears a definite relationship to its power to decompose the specific polysaccharide *in vitro*.

In addition to its protective action, the active principle has been found to exert a specific prophylactic and curative effect on experimental Type III pneumococcus infection in mice.

OSWALD T. AVERY
RENE DUBOS
HOSPITAL OF THE ROCKEFELLER INSTITUTE
FOR MEDICAL RESEARCH, NEW YORK

BOOKS RECEIVED

APPLETON, A. B. *Laboratory Guide to Vertebrate Dissection for Students of Anatomy.* Pp. xix + 152. Cambridge University Press. 6s.

CORNER, GEORGE W. *Clio Medica: Anatomy.* Pp. xvii + 82. Hoeber. $1.50.

EVANS, GRIFFITH C. *Mathematical Introduction to Economics.* Pp. xi + 177. 30 figures. McGraw-Hill. $3.00.

FORT, TOMLINSON. *Infinite Series.* Pp. iv + 253. Oxford University Press.

FRANKLIN, WILLIAM S., and G. E. GRANTHAM. *General Physics.* Pp. xvi + 705. Illustrated. Franklin and Charles. $4.00.

HEISENBERG, WERNER. *The Physical Principles of the Quantum Theory.* Pp. xii + 186. Illustrated. University of Chicago Press. $2.00.

HRDLIČKA, ALEŠ. *The Skeletal Remains of Early Man.* Pp. x + 379. Smithsonian Institution.

JULL, MORLEY A. *Poultry Husbandry.* Pp. ix + 639. 229 figures. McGraw-Hill. $4.00.

KAUFFMANN, HUGO. *Allgemeine und Physikalische Chemie.* Pp. 148. 4 figures. Walter de Gruyter & Company, Berlin. RM. 1.80.

THOMAS, CHRISTO. *Cosmogony: A Theory of Cosmo-Dynamics.* Pp. 152. Christopher Publishing House. $1.75.

WARMING, EUGENE, and P. GRAEBNER. *Lehrbuch der ökologischen Pflanzengeographie.* Pp. 240. 99 figures. Verlag von Gebrüder Borntraeger, Berlin. 24M.

WRIGHT, WILMER C., Translator. *Hieronymi Fracastorii de Contagione et contagiosis Morbis et eorum Curatione, Libri III.* History of Medicine Series, No. II. Pp. lvii + 356. Putnam's. $4.50.